# DECREASE IN ABSOLUTE EOSINOPHIL COUNT AS A RELIABLE MARKER OF MORTALITY IN PERFORATIVE PERITONITIS

*Dissertation Submitted to*

**THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY**

***in partial fulfillment of the regulations***

***for the award of the degree of***

## M.S. (GENERAL SURGERY)

## BRANCH – I

**GOVT. STANLEY MEDICAL COLLEGE & HOSPITAL**

**THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY**

**CHENNAI, INDIA.**

**APRIL 2015**

# CERTIFICATE

This is to certify that this dissertation entitled "**DECREASE IN ABSOLUTE EOSINOPHIL COUNT AS A RELIABLE MARKER OF MORTALITY IN PERFORATIVE PERITONITIS"** is the bonafide original work done by **Dr. V.Manivannan, M.S.,** Post graduate in General Surgery(2012-15), under my overall supervision and guidance in the Department of General Surgery, Stanley Medical College, Chennai, in partial fulfillment of the regulations of The Tamil Nadu Dr. M.G.R. Medical University for the award of **M.S Degree in General Surgery (Branch I).**

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# DECLARATION

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Place: Chennai.

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## CONTENTS

## ABBREVIATIONS

| | |
|---|---|
| AEC | Absolute Eosinophil Count |
| APACHE | Acute Physiology and Chronic Health Evaluation |
| CRP | C- Reactive Protein |
| CAPD | Continuous Ambulatory Peritoneal Dialysis |
| DPL | Diagnostic Peritoneal Lavage |
| EDTA | Ethylene Diamine Tetra Acetic Acid |
| FAST | Focussed Assessment with Sonography |
| ICAM | Intercellular Adhesion Molecule |
| IL | Interleukin |
| JPS | Jabalpur Prognostic score |
| MIS | Minimally invasive surgery |
| NF- κB | Nuclear Factor Kappa |
| NSAID | Non steroidal anti inflammatory drugs |
| SBP | Spontaneous Bacterial Peritonitis |
| TNF | Tumor Necrosis Factor |
| TNF | Tumor Necrosis Factor |
| VCAM | Vascular Cell Adhesion Molecule |
| WHO | World Health Organisation |

# INTRODUCTION

Perforative peritonitis is the commonest surgical emergency in India. Inspite of advances in diagnosis , intensive care treatment, surgical techniques and antimicrobial therapy management of perforative peritonitis continues to be challenging for the surgeons.

Peritonitis is the commonest cause of sepsis in developing countries. Despite the treatment measures, mortality rates are still high (upto 40%).In addition to this in developing countries, most of the patients present to the clinic late with septicemia, increasing the morbidity and mortality of the disease . This increases the need for a tool predicting the morbidity and mortality in patients with perforative peritonitis.

The etiological spectrum of perforative peritonitis in india differs significantly from its western counterparts. It is commonly seen in younger age groups. The site of perforation is most commonly involves the proximal part of the gastrointestinal tract whereas it is distal in the western countries.

Etiological factors also show a wide geographical variation. In India the most common causes of perforation are peptic ulcer, typhoid followed by appendicular and tubercular perforations.

The most important factors responsible for the mortality are Septicaemia and Shock.

A rapid and persistent decrease in the numbers of circulating eosinophils is a distinctive aspect of physiological response to acute inflammation. Eosinopenia (<50 cells/dl) may be the result of migration of eosinophils into the inflammatory site due to release of the chemotactic factors.

Many recent reports have shown that eosinopenia as a marker of sepsis. This promoted us to assess the diagnostic value of eosinopenia as mortality marker in patients with perforative peritonitis.

# REVIEW OF LITERATURE

## History

Ebers papyrus (Egypt) 1500 BC contains the first description of peritoneum. Douglas in 1730 was the first to give the detailed description of peritoneum, thereafter various personalities gave their contribution in its structure, function and pathological conditions.

Winslow in 1732 described greater and lesser omentum, lesser sac and foramen of Winslow. Morrison in 1894 described the right subhepatic pouch and functions of omentum.

Milkulicz first proposed the basic principles of management of peritonitis involving early operation, source control and lavage. In 1926, Kirschner et al reported that mortality decreased from >90% to <40% with the introduction of operative procedures.

In 1980 Fry et al showed that mortality based on number of failed organs. Mortality was 3% when no organ failure, which increased to 30% with one major organ failure and to 100% with four major organ failures.

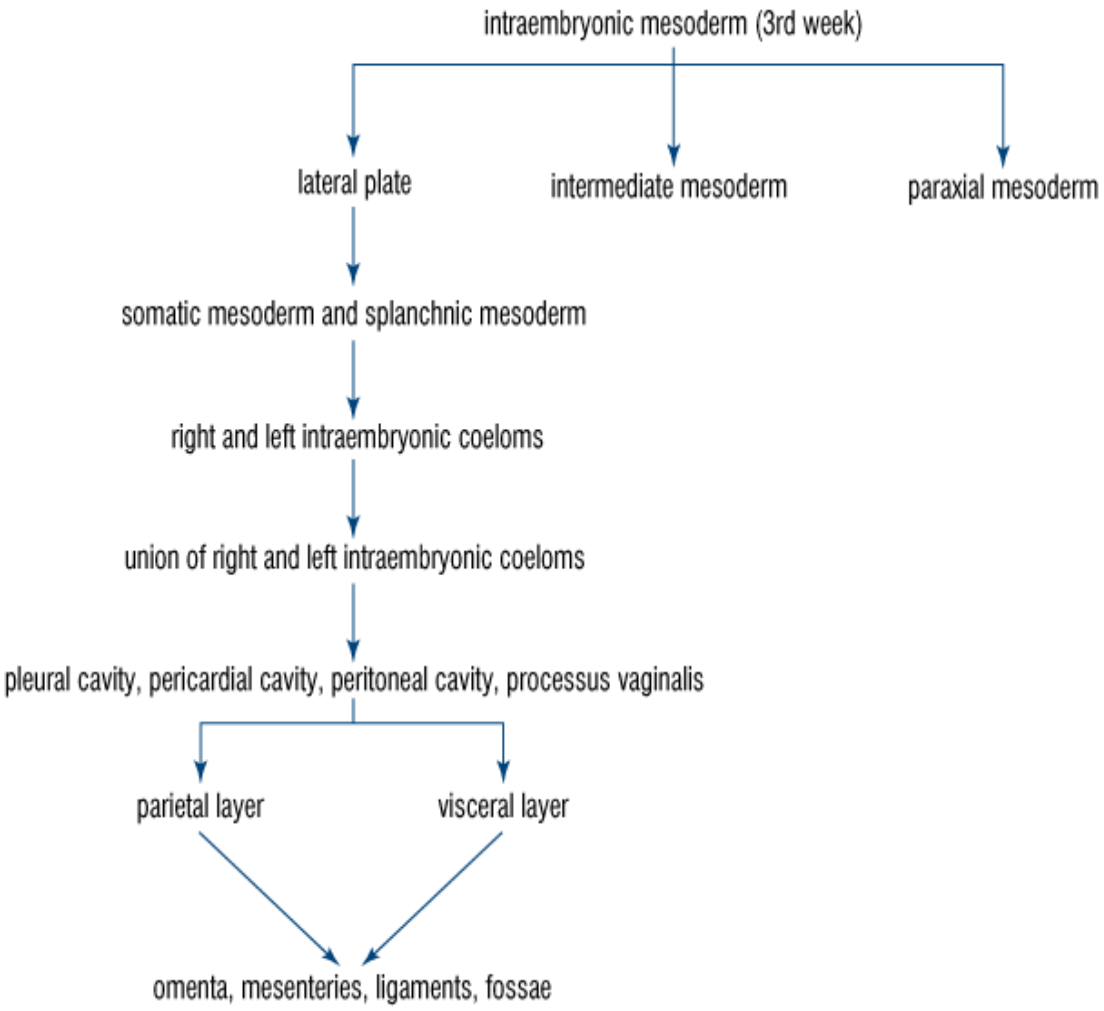
## ANATOMY OF PERITONEUM AND PERITONEAL CAVITY-

The peritoneum forms the largest cavity in the body and divided into parietal and visceral peritoneum. It is made up of single layer of flat mesothelial cells and connective tissue. The peritoneum forms a closed cavity in males, but in females it is opened to exterior via fallopian tube.

The parietal peritoneum is loosely adherent to abdominal wall and pelvis, but visceral one is densely adherent to viscera and became a wall of viscera, that can't be separated. The cavity contains minimal fluid, water, protein, electrolytes and solutes, and provides lubrication for visceral movements(1).

The total surface area of the peritoneum is 2 $m^2$, acts as a two directional dialysis membrane through which the passage of solutes of both small and large molecular weight, by the process of osmosis(2,3). The following factors can alter the absorption of solutes based on abdominal pressure, temperature, pH, portal pressure, lymphatic blockade and scarring in the peritoneum(4,5). The defense mechanism of the peritoneum is a complex one, that maintain an innate immunity against infection and inflammation (6,7).

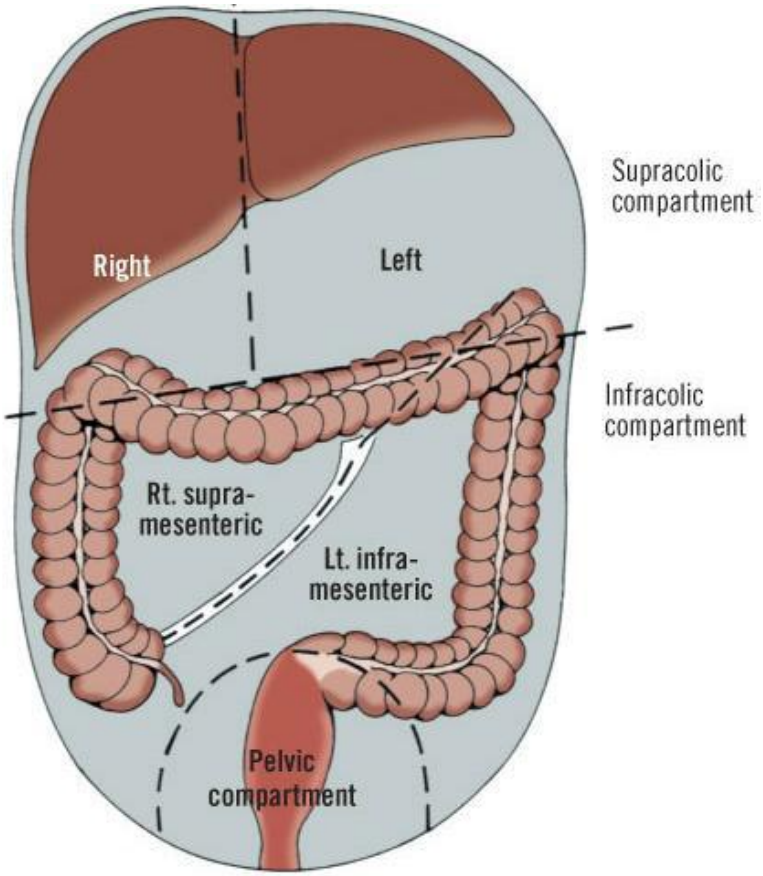
**EMBRYOLOGY(8)**




Embryologically, peritoneum is derived of the primitive celom, by division of the lateral mesoderm into somatic and splanchnic layers(9). The parietal peritoneum, developing from the somatic division, covers the abdominal cavity, diaphragm and pelvis. The visceral peritoneum, derived of the splanchic layer, lines the organs inside the peritoneum and are the mesenteries .

**ARRANGEMENT OF PERITONRAL CAVITY-**

It contains greater sac, which is the main abdominal cavity & lesser sac or omental bursa, which is posterior to the stomach. For practical purpose the peritoneal cavity is divided into 2 compartments, supramesocolic and inframesocolic, based on transverse colon and transverse mesocolon(1).



**Supramesocolic compartment**

This compartment lies between diaphragm and transverse colon. It is divided into right and left space. The right space is subdivided into 3 spaces, they are right subphrenic, right subhepatic and lesser sac. The left space is subdivided into 2 spaces, they are left subphrenic space and left perihepatic space.

**Inframesocolic compartment**

This compartment lies between transverse colon and true pelvis. It is divided into unequal right and left spaces by small bowel mesentery. It also contains right and left paracolic gutter.

The peritoneal cavity is divided into multiple spaces by eleven ligaments and mesenteries. They are coronary, gastrohepatic, hepatoduodenal, falciform, gastrocolic, duodenocolic, gastrosplenic, splenorenal, and phrenicocolic ligaments, the transverse mesocolon and the small bowel mesentery(10).

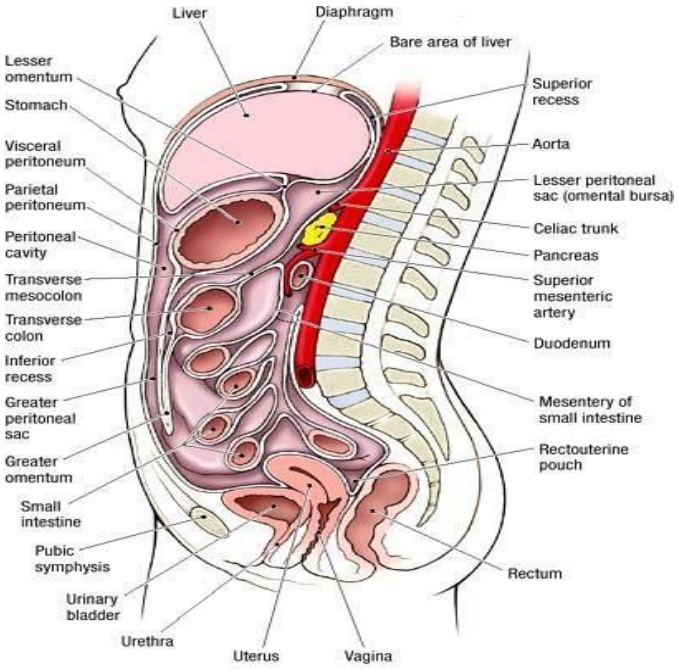
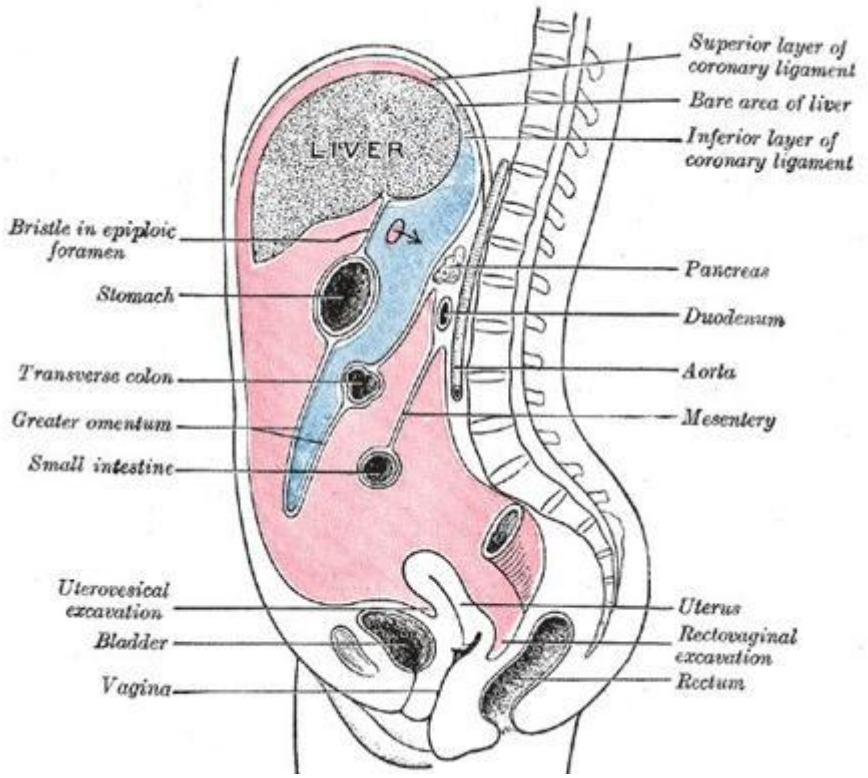



Figure 4.20. Peritoneum and peritoneal cavity, median section.

These ligaments and mesenteries divide the abdomen into nine spaces:

1. Right and left subphrenic space,
2. Subhepatic space,
3. Supramesenteric and inframesenteric space,
4. Right and left paracolic gutters,
5. Pelvis and lesser space.




COMPARTMENTS OF PERITONEUM LATERAL VIEW

The ligaments, mesentries, and peritoneal spaces dictate the movement of the ascitic fluid and are of immense help in predicting the route of spread of infectious and malignant diseases.

The left paracolic gutter is infracolic only, interrupted by phrenicocolic ligament whereas the right paracolic gutter extends into supracolic space also. Pelvic cavity is divided into right & left by sigmoid colon & rectum, further divided in females into anterior & posterior by

broad ligament, fallopian tubes & uterus. Extra peritoneal spaces are Bare area of liver, Diaphragm and Left extra peritoneal space .

**Parts of peritoneum;**

1. Omenta – greater & lesser

2. Mesentery – of small intestine, meso appendix , transverse mesocolon

3. Ligaments - of liver, bladder, uterus

4. Fossae – duodenal, ileal, intersigmoid

Derivatives of peritoneum:

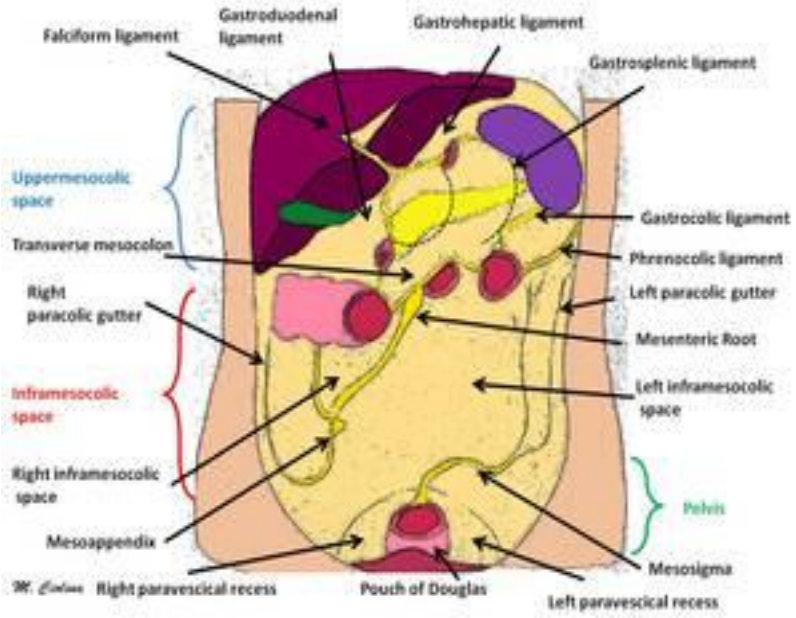
**Omentum:**

There are two commonly derived omental folds, greater and lesser omentum.

**Lesser Omentum**

It is a double layer of peritoneal fold extending from lesser curvature of stomach and duodenum to liver. The right free margin(gastroduodenal ligament) contains hepatic artery, portal vein, bile duct, lymph nodes and lymphatics and hepatic plexus of nerves. It forms the anterior wall of lesser sac and allows fluid collection and abscess

formation in lesser sac during any pathologic process especially of pancreas.




**Greater Omentum**

Greater omentum is the largest peritoneal fold. It is folded on itself to form four layered sheath. It extends from greater curvature and first part of duodenum downwards up to pubic symphysis, folds on itself to ascend and adhere to peritoneum on superior surface of transverse colon and mesocolon. This line of fusion is known as Avascular plane of Toldt. The left border is continuous with gastrosplenic ligament.

The greater omentum is thin and cribriform and always contain some adipose tissue. Between two layers of anterior fold, it contains right

and left gastroepiploic vessels forming an anastomotic arc which is to be preserved during gastric mobilization. Tiny white opaque oval or irregular shaped spots or bodies(milky spot) may be described within thin membranes of omentum in children and lean adults. Their number decreases with age. Their size increases with pathological conditions in abdomen. Microscopically it contains glomus like pattern of vascular structure, cellular population of fibroblasts, lymphocytes, plasma cells, fat cells and specialised mesothelial cells.

**HISTOLOGY & PHYSIOLOGY(11)**

Both Parietal & visceral parts of the peritoneum have same histology – basement membrane covered by single layer of mesothelial cells. Parietal layer is very loosely attached to preperitoneal fat but visceral layer is fixed firmly to subserosa of GI tract. Peritoneal cavity is a potential space with about 50ml of isotonic fluid & less than 300 mononuclear cells.

**BLOOD SUPPLY**

The blood supply of peritoneum and mesentry are from the splanchnic system (main), lower intercostals, lumbar, and iliac arterial branches.

**INNERVATION**

The nerve supply of the parietal layer is by somatic nerves, contains many sensory fibers for sensation of pain. Visceral layer is relatively insensitive to pain as there is no somatic afferents. So a perforated viscous may produce anterior abdominal wall rigidity and intra peritoneal fluid collection, produces sensation of traction or tension on the mesentery in the retroperitoneal space but not localized pain.

**Functions of peritoneum**

1. Pain perception,
2. Visceral lubrication,
3. Fluid and particulate absorption,
4. Inflammatory and particulate absorption &
5. Fibrinolytic activity.

# PERITONITIS

"Intraabdominal infection may be defined as clinical peritonitis with operative and microbiological proof of infection(12,13)". The name includes a group of pathologies namely primary, secondary, tertiary peritonitis and intraabdominal abscess. In spite of research and

developments in surgical management, antibiotics, and intensive care treatment, death rate of 5-40% are reported(12-20).

| Classification of peritonitis based on etiology | |
|---|---|
| I. Primary Peritonitis<br>A. Spontaneous peritonitis in Children<br>B. Spontaneous peritonitis in Adults<br>C. Spontaneous peritonitis in CAPD<br>D. Tubercular peritonitis | III. Tertiary Peritonitis<br>A.Peritonitis without pathogens<br>B. Peritonitis with fungi |
| II. Secondary Peritonitis<br>A. Acute Perforative Peritonitis<br>1.GI tract perforation<br>2.Intestinal ischemia<br>3.Pelvic peritonitis<br>4.Others<br>B. Post operative peritonitis<br>1.Anastomotic leak<br>2. Stump insufficiency<br>3. Other iatrogenic leaks<br>C. Post traumatic peritonitis<br>1. After blunt abdominal trauma<br>2. After penetrating abdominal trauma<br>3. Others | IV. Intarabdominal Abscess<br>A. Associated with Primary Peritonitis<br>B. Associated with Secondary Peritonitis<br>C. Associated with Tertiary Peritonitis |

## PRIMARY OR NONSURGICAL BACTERIAL PERITONITIS

Occuring in the absence of gastrointestinal perforation is caused mainly by hematogenous spread but occasionally by transluminal or direct bacterial invasion of the peritoneal cavity. Impairment of the hepatic reticuloendothelial system and compromised peripheral destruction of bacteria by neutrophils promotes bacteremia, which readily infects ascitic fluid that has reduced bacterium-killing capacity.

## PRIMARY PERTONITIS- ETIOLOGY

1. Spontaneous bacterial peritonitis,
2. Peritonitis with CAPD,
3. Tuberculous etiology,
4. Peritonitis with AIDS,
5. Chlamydia infection,
6. Gonorrhoeae infection,
7. Others- PAN, SLE, Scleroderma, Familial Mediterranean fever, etc,,

## PATHOGENESIS OF SBP:

The commensal organisms in the gut forms the main source of infection in spontaneous bacterial peritonitis. SBP occurs in cirrhosis

and advanced liver disease with a low ascitic fluid protein concentration. It is also seen in patients with nephrotic syndrome, connective tissue disorder, or after splenectomy during childhood. Recurrence occurs in cirrhosis and prognosis is fatal.

The clinical presentation simulates secondary bacterial peritonitis, with abrupt onset of fever, abdominal pain, distention, and rebound tenderness. However, one-fourth of patients have minimal or no peritoneal symptoms. Most patients will have clinical and biochemical manifestations of advanced cirrhosis or nephrosis. Leukocytosis, hypoalbuminemia, and a prolonged prothrombin time are characteristic findings. The diagnosis is made when ascitic fluid culture is positive & polymorphonuclear count >250 cells/mm3, with no evidence of surgical peritonitis ( 21). Bacteria are seen on Gram-stained smears in only 25% of cases. Culture of ascitic fluid inoculated immediately into blood culture media at the bedside usually reveals a single enteric organism, most commonly E coli, klebsiella, or streptococci, but Listeria monocytogenes has been reported in immunocompromised hosts.

## SECONDARY OR SURGICAL BACTERIAL PERITONITIS

The causes of secondary bacterial peritonitis is include diseases of the bowel or injury to the bowel, leading onto discontinuity of the GIT and spillage of these contents into peritoneal cavity(22). This is further divided into acute suppurative peritonitis, granulomatous peritonitis, and chemical peritonitis(23).

Systemic sepsis due to peritonitis occurs in varying degrees depending on the virulence of the pathogens, the bacterial load, and the duration of bacterial proliferation and synergistic interaction. Surgical peritonitis is diagnosed when ascitic fluid culture is positive for multiple organism, PMN count> 250 cells/mm3 & intra-abdominal surgical treatable primary source of infection (24).

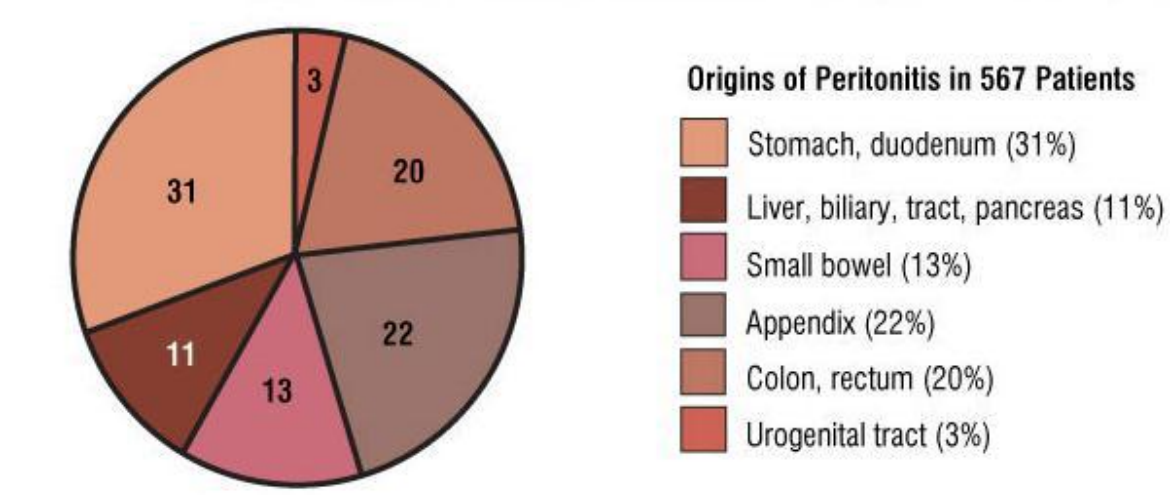
In most of the cases the peritoneal contamination is caused by mixed flora both aerobic and anaerobic. Anatomical, pathological, and surgical factors may favour localization of peritonitis . However , in majority of the cases peritonitis becomes diffuse when it occurs in patients with sudden anatomical disruption, extremes of age, immunodeficiency , perforation proximal to obstruction, stimulation of peristalsis and following trauma. The clinical presentation of the patients

depends upon the site of perforation. Patients of duodenal perforation present with a short history of pain epigastrium or upper abdomen along with generalized tenderness and guarding. In patients of diverticulitis patients are generally of old age and past history of constipation is present along with signs of peritonitis. Appendicular perforations have a characteristic pain starting in periumbilical area or right iliac fossa along with vomiting and fever. There are also conspicuous signs present like guarding and rebound tenderness in right iliac fossa. Ileal perforations are usually preceeded by a history of some medical disease followed by sudden onset of lower abdomen pain, vomiting, abdominal guarding and distention later on. In patients of trauma generalized peritoneal signs start developing after 2-3 hours of injury.

**MOST COMMON CAUSES OF SECONDARY SUPPURATIVE PERITONITIS-**

1. Perforated peptic ulcer disease,
2. Appendicitis,
3. Diverticulitis,
4. Acute cholecystitis
5. Perforated Typhoid and Tuberculosis ulcer,
6. Perforated carcinoma,

7. Penetrating trauma, and
8. Post surgical complications.




## PEPTIC ULCER PERFORATION

The incidence rates of hospitalisation, emergency surgery and post operative morbidity and mortality for peptic ulcer perforation remain stable for the past two decades. In elderly, the incidence of duodenal ulcer perforation is increased than gastric perforation.

**Duodenal ulcer** remains the causative agent for approx 75% of peptic perforations. The mortality rate of perforated peptic ulcer is more in the elderly with gastric perforations than with duodenal perforations.

Comorbid illness, late presentation to the clinic, extensive surgery and post operative sepsis have been associated with increased morbidity and mortality in this disease.

The management of duodenal ulcer perforation is simple open closure vs minimally invasive approach. The simple closure without acid reduction techniques remains the mainstay of treatment although all the procedures can be performed laproscopically. The laproscopic approach is challenging for perforated ulcer because of difficulty in two hand manipulation and intracorporeal suturing of indurated and friable tissue. Although laproscopic closure of perforated duodenal ulcer is simple and safe and has the benefits of shorter surgery duration, less postoperative pain, earlier mobility and less morbidity than the open approach.

In patients with shock, high APACHE scores open approach is better than minimally invasive surgery.

In peptic ulcer perforation, associated with H.pylori, the management is closure of the perforation with interrupted suture. The point of perforation is first identified over the proximal anterior aspect of the duodenum. If the perforation is not identified, complete exploration of the entire duodenum, gastric walls and jejunum are to be done.

Omentum is laid over the closure and secured with the ends of previous suture. Additional suuring can be done if necessary.

Patients without generalised peritonitis, hemodynamic instability or free peritoneal perforation can be considered for conservative management.

Antisecretary drugs and antibiotics are to be prescribed to the patient postoperatively to eradicate H.pylori. Many drug treatment regimens are available. The treatment has to be completed and after that eradication of H.pylori has to be confirmed because eradication of H.pylori is associated with decreased ulcer recurrence.

Older practice of acid reduction surgery with perforation closure is not done today because of the increased post operative complications of vagotomy and gastrectomy in contrast to simple closure of the perforation.

Indications for simple closure:

- Generalised peritonitis
- Shock
- Perforation > 24 hrs
- No significant symptoms 3months before perforation

Indications for acid reduction surgery with perforation closure:

- Unclear diagnosis
- Obstruction
- Chronic ulcer refractory to therapy

H.pylori infection, NSAID ,smoking, alcohol abuse form the risk factors for peptic ulcer perforation.

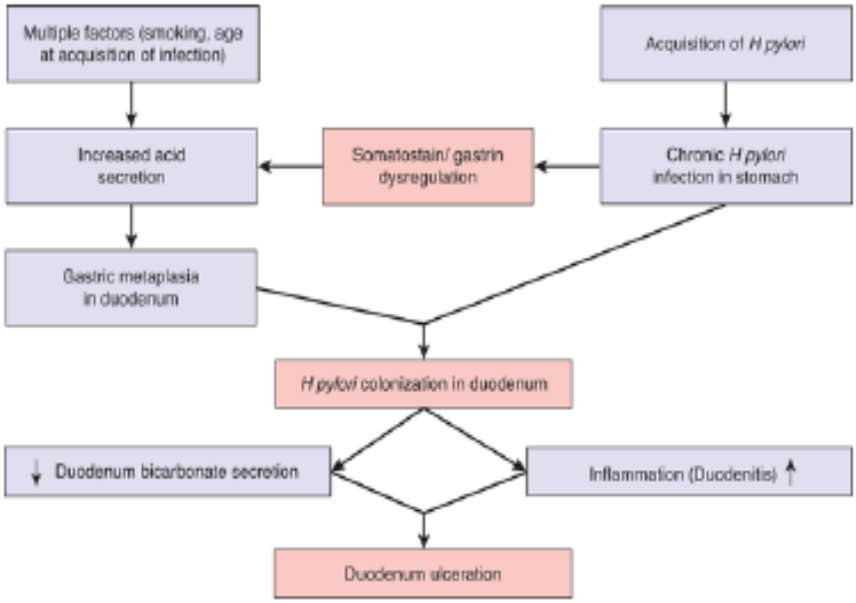
**H.PYLORI & PEPTIC ULCER:**

Patients with H.pylori infection and antral gastritis are three and a half times more likely to develop peptic ulcer disease than patients without H.pylori infection.

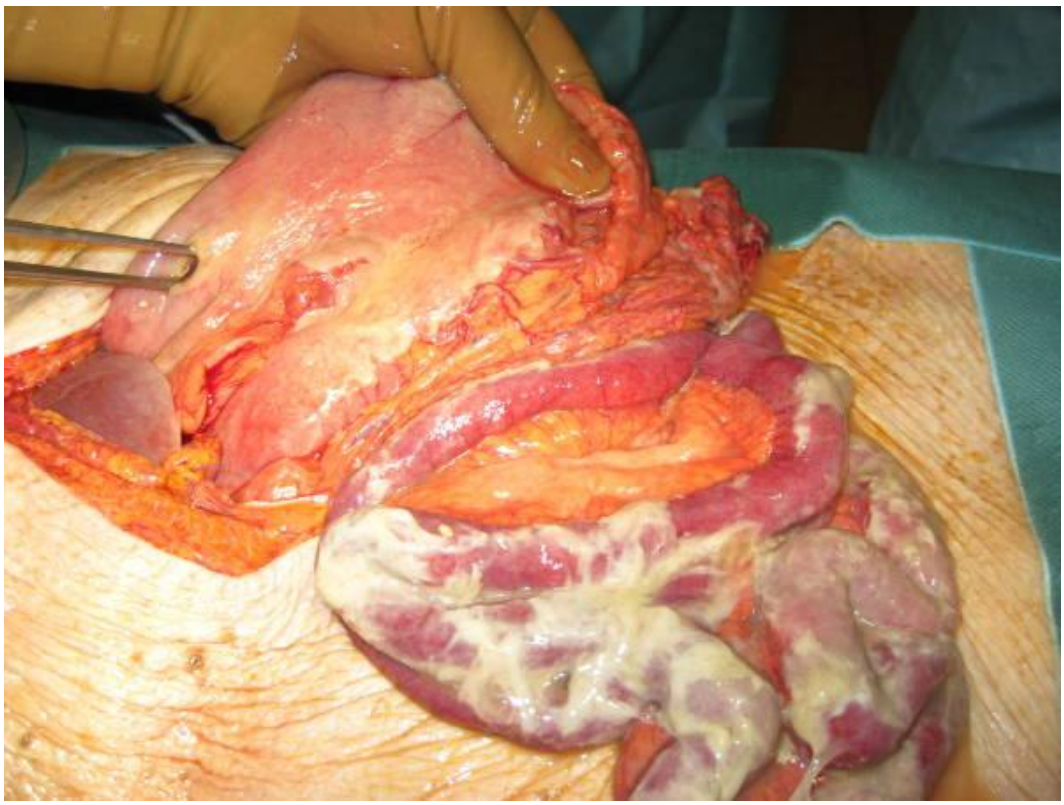
Up to 90% of patients with duodenal ulcers, and 70 to 90% of patients with gastric ulcers, have H.pylori infection.

Sex: The ratio is 2 men to 1 woman.

Age: The highest incidence is between 45 and 55 years.




**PATHOGENESIS OF PEPTIC ULCER DISEASE**



Most often a peptic ulcer that perforates is situated on the anterior surface of the duodenum; much less frequently it is situated on the anterior surface of the stomach, usually near the lesser curvature or the pyloric antrum. Rarely an ulcer on the posterior wall of the stomach perforates into the lesser sac.

In 80 per cent of cases, there is a history , often a long history of peptic ulceration. In 20 per cent there is no such history; it is a silent‘ chronic ulcer that perforates, especially in those patients who are being treated with cortisone.

**NSAID induced GI damage:**

Risk of significant serious adverse GI events in patients taking NSAIDs is more than three times that of controls. This risk increases to five times in patients over age 60. In elderly patients taking NSAIDs, the likelihood that they will require an operation related to a GI complication is 10 times that of the control group, and the risk that they will die from a GI cause is about four and a half times higher.

>20% of patients with perforation of >60 years age group have had history of NSAID consumption.

NSAIDs cause GI damage by

1. Topical biochemical reactions – inhibition of COX prevents mucosal repair because of decreased prostaglandin synthesis leading to decreased mucosal blood flow.

2. Inflammatory tissue reaction because of increased permeability that allows luminal aggressive factors access to mucosa – NSAIDs uncouple mitochondrial oxidative phosphorylation with consequent decrease in intracellular ATPs loss of cytoskeletal control over tight junctions.

**Smoking, Stress, and Other Factors**

Epidemiologic studies suggest that smokers are about twice as likely to develop peptic ulcer disease as nonsmokers. Smoking increases gastric acid secretion and duodenogastric reflux. Smoking decreases both gastro duodenal prostaglandin production and pancreaticoduodenal bicarbonate production.

Although difficult to measure, both physiologic and psychological stress undoubtedly play a role in the development of peptic ulcer in some patients. In 1842, Curling described duodenal ulcer and/or duodenitis in

burn patients. Decades later, Cushing described the appearance of acute peptic ulceration in patients with head trauma (Cushing ulcer). Patients still present with ulcer complications (bleeding, perforation, and obstruction) that are seemingly exacerbated by stressful life events.

Recently, the use of crack cocaine has been linked to juxtapyloric peptic ulcers with a propensity to perforate. Alcohol is commonly mentioned as a risk factor for peptic ulcer disease, but confirmatory data are lacking

## PERFORATION IN ENTERIC FEVER

Enteric fever is caused by salmonella typhi

Most common in 21-30 age group.

Disease is common in lower socioeconomic status mainly due to contaminated water supply.

Majority of the perforations occur within 2 wks of illness.

**TYPHOID ULCER PERFORATION**

Mechanism – hyperplasia &necrosis of peyers patches in terminal ileum leading to tissue damage. Necrosis may end up with full thickness perforation.

Ulcers of the terminal ileum in typhoid fever

**Treatment:**

Closure of perforation & appropriate antibiotics.

## BILE PERITONITIS

**Causes**

1) Perforated cholecystitis

2) Post cholecystectomy

i. Cystic duct stump leakage

ii. Division of accessory duct

iii. Bile duct injury

iv. T - tube drain dislodgement

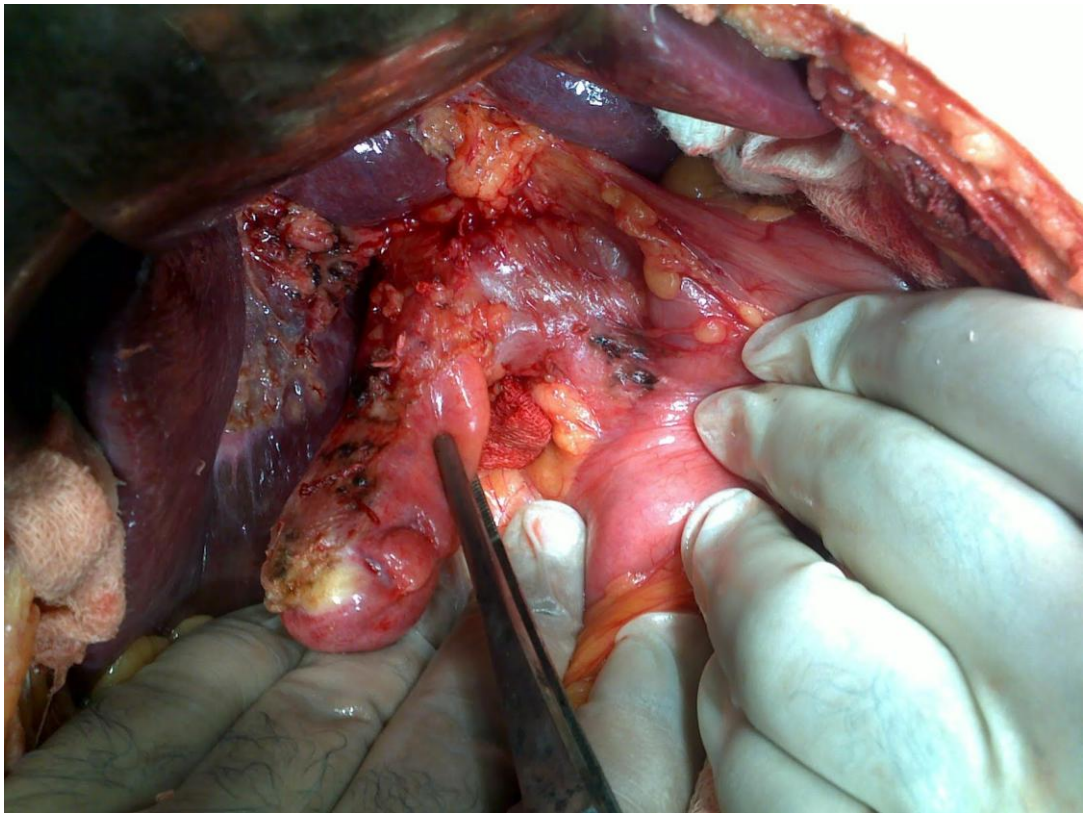
3) Following other operations/ procedures

i. Leaking duodenal stump post gastrectomy

ii. Leaking biliary enteric anastomosis

iii. Leaking around percutaneously placed biliary drains.

Unless the bile has extravasated slowly and the collection gets shut off from the general peritoneal cavity usually the bile leak leads to diffuse peritonitis due to the high irritant nature of the bile, the patient is often jaundiced due to absorption of peritoneal bile.



Treatment

Laparotomy or laparoscopy done to evacuate the bile, peritoneal lavage and source of bile leakage identified and corrected.

## MECONIUM PERITONITIS

Meconium is a sterile mixture of epithelial cells, mucin, salts, fats and bile. Meconium peritonitis is an aseptic peritonitis with meconium entering the peritoneal cavity through an intestinal perforation which may be due to some form of neonatal intestinal obstruction. It is considered

when a baby is born with a tense abdomen, is vomiting and in whom there is failure to pass meconium.

Radiography shows free air in the peritoneal cavity, fluid levels, fluid in the abdomen and calcification most often on the surface of liver or spleen.

**Treatment**

Laparotomy - closure of perforation and drainage of peritoneal cavity.

## TRAUMATIC PERITONITIS

Most of the trauma patients tend to have abdominal injuries. According to 2009 NTBD, 13% of trauma patients sustained abdominal injuries and associated with an overall mortality of 7.7%. Abdominal injuries are prime important, because of the location of the vital organs in abdomen and injuries lead to life threatening complication immediately and hence should be sought first. Penetrating injuries of abdomen causes laceration of solid organs and perforation of hollow viscus.

**Blunt injury abdomen:**

In blunt injury abdomen, when patients presents in unstable condition, FAST should be done to rule out hemoperitoneum, if USG was unavailable then aspiration of 10 ml of blood in DPL confirms hemoperitoneum. When these patients presents in stable condition and peritonitis, laprotomy should be conducted to treat hollow viscus perforation.

64 and 128 channel CT machines are the best investigation of choice to rule out perforation in abdominal trauma. Bowel wall thickening, fat stranding and free fluid in the abdomen are the positive signs in diagnosis of perforation of hollow viscus. Oral contrast CT is not routinely needed and it also lead to complication like aspiration. These CT findings with abdominal tenderness and seat belt mark are enough to diagnose bowel perforation.

If CT finding is equivocal and in patients with head injury, diagnostic peritoneal lavage should be done. The presence of >500 WBC/$mm^3$, amylase, bilirubin or particulate material confirms the diagnosis of hollow viscus perforation.

**Penetrating injuries**

The gunshot injury patients are immediately shifted to operation theatre. The direction of entry of missiles can help in identifying the injured organs and deep search of injuries should be done.

When patients with peritonitis, unstable and evisceration require immediate laparotomy. Other patients are evaluated locally for any breach in fascial planes. If there is no fascial violation patients are discharged home. If the test is positive or equivocal, patients should be observed after 8 hours for peritonitis or a diagnostic laproscopy should be done to rule out injuries.

CT scan is the best investigation to identify injuries involving vertebra, spinal cord, major vessels and pelvic injuries. Examination of injury tract can help in identifying the vital structure involvement. When the tract enters the abdominal cavity laparotomy should be done.

During laparotomy systematic examination of all the areas and organs should be done. If the patient is unstable, laparotomy with incision from xiphoid process to pubic symphysis should be done to examine all the organs. The entire gastrointestinal tract from the oesophago-gastric

junction to rectum should be done. The lesser sac is opened, posterior stomach should be evaluated.

GASTRIC INJURIES:

Stomach is the most common organ involved in penetrating injuries than blunt injuries. Penetrating injuries lead to full thickness perforation with leakage of gastric contents and associated with high mortality. Blunt injury abdomen can lead to increase in intra-luminal pressure leading on to bursting of stomach.

In large intramuscular hematoma, perforation is ruled out and evacuation of hematoma followed by closure of sero-muscular layer with non-absorbable suture material is done. In full thickness perforation, the devitalised tissues are removed and closure of stomach done in 2 layers. When larger areas are involved then plan for sub-total or total gastrectomy, followed by Billroth I or II gastro-enterostomy or by Roux-en-y oesophagojejunostomy.

DUODENAL INJURIES:

The injuries when abdomen struck over stearing wheel or child fall over bicycle handle bar can lead to duodenal injuries. The mechanism

of injury is blow out injuries. The presentation are hematoma to presentation. As the duodenum is retro-peritoneal the abdominal signs are absent. Hematomas are best dealt conservatively. If the hematomas are large to cause gastric outlet obstruction, gastric decompression should be done for 2 weeks followed by CT scan. If the perforation is present single or double layered closure should be conducted after adequate kocher manoeuvre.

SMALL BOWEL INJURIES:

This is the most common organ involved in penetrating injury. In blunt trauma the mechanism of injury are crushing, rupture and shearing forces against vertebral column. Minor perforation are closed anatomically and if the involvement is more than 50% of circumference then resection and anastomosis should be done.

COLONIC INURIES:

This is most common after penetrating injuries, and the mechanism of injury and treatment modality are similar to small bowel injuries. In case of rectal injuries, diversion procedure in the form of loop or end colostomy and presacral drainage should be done.

## GRANULOMATOUS PERITONITIS

In granulomatous peritonitis, the peritoneal inflammation is associated with formation of granulomas and adhesions. The causes of granulomatous peritonitis are tuberculosis, fungal ( e.g., Candida, Histoplasma), amoebic, and parasitic infections. Iatrogenic causes of granulomatous peritonitis are related to glove lubricants ( e.g., talc, cornstarch) or cellulose fibres from gauze, surgical drapes.

## TUBERCULOUS PERITONITIS

After an initial decrease in incidence of tuberculosis due to ATT, there is a re-emergence of this disease due to the increase in acquired immune deficiency syndrome and there is an increase in incidence of multidrug-resistant tuberculosis. Other risk factors for the occurrence of tuberculosis are poorly nourished, debilitated patients, CAPD patients, cirrhosis, diabetes and malignancy.

Inspite of involving peritoneum, abdominal tuberculosis also invade omentum, intestinal tract, liver, spleen and female genital tract. The incidence of abdominal tuberculosis is 11% to 16% of the total extrapulmonary tuberculosis. The entry of mycobacterium tuberculosis into the peritoneum is by transmurally from diseased bowel, from

tuberculous salphingitis and hematogenous spread from a pulmonary focus.

The onset of tuberculous peritonitis is insidious, with more than 70% of patients having had symptoms for more than 4 months before definitive diagnosis. The common symptoms are constitutional and include fever, anorexia, weakness, malaise and weight loss. Abdominal distension are due to ascites or by partial obstruction. Examination shows diffuse tenderness, but the classic doughy abdomen is rarely present. CXR shows pleural effusion and pulmonary infiltrate. Xray abdomen doesn’t show any benefit, but CT scan shows thickened bowel and ascites.

CT ABDOMEN SHOWING FEATURES OF TUBERCULOUS PERITONITIS

**Diagnosis:**

Tuberculin skin test

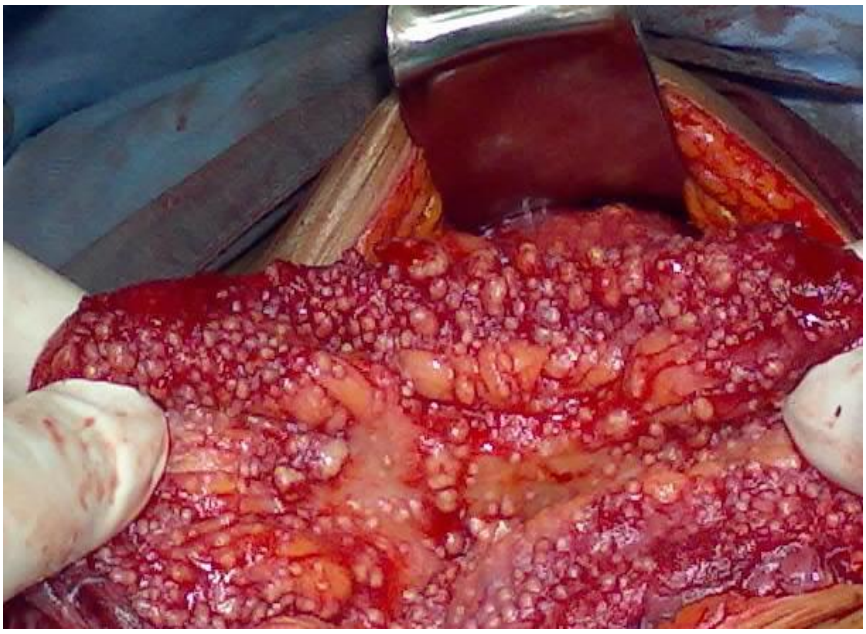
Tuberculin skin tests usually gives positive result in peritonitis of tuberculous etiology, but a negative test does not rule out the disease.

Ascitic Tap

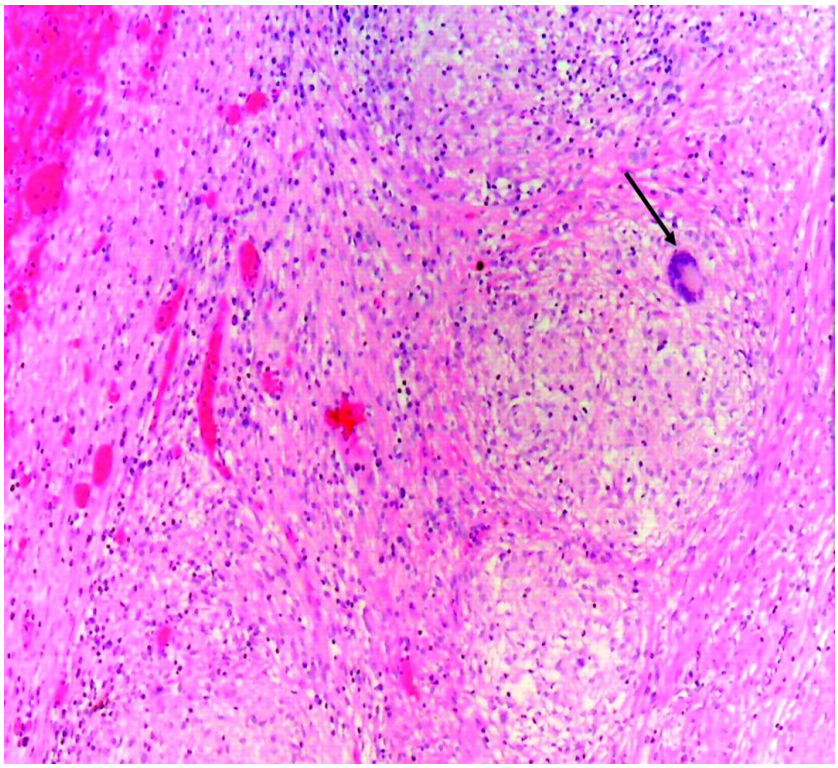
Ascitic fluid biochemical analysis shows protein content of exudative pattern(> 3.0 g/dL), and glucose < 30mg/dL. The haematological analysis of the fluid shows WBC >250 cells/cu.mm with lymphocytic predominance. Acid fast staining usually give negative results. Liquid BACTEC culture requires 4-6 weeks incubation. There is lack of a promising rapid diagnostic test for tuberculous peritonitis.

**Surgery**

Diagnostic laproscopy with biopsy is considered the gold standard in the diagnosis of peritoneal tuberculosis. The findings are stalactite like fibrinous masses in the parietal peritoneum; multiple granulomas in the peritoneum.



TUBERCULOUS PERITONITIS



PERITONEAL TISSUE SHOWING TWO NECROTISING GRANULOMAS. ARROW INDICATES GIANT CELL

**Differential Diagnosis**

Acute presentation

- A/c appendicitis
- A/c Cholecystitis
- Perforated ulcer
- A/c Salphingitis

Chronic presentation

- Crohn's disease
- Carcinoma

**Treatment**

Similar to the treatment of pulmonary tuberculosis. Treatment consists of 4 drug regime (INH, Rifampicin, Pyrazinamide, Ethambutol) for 6 months.

## CHEMICAL (ASEPTIC) PERITONITIS

This type of peritonitis occurs due to spillage of irritant materials which is often complicated by secondary bacterial infection.

Causes

- Bile
- Urine
- Chyle
- Barium sulphate

**Treatment**

IV fluids, antibiotics and laprotomy

## PERITONITIS IN CAPD PATIENTS

The most common complication of CAPD is bacterial contamination of the peritoneal cavity. It occurs as a complication affecting 1.1-1.3 episodes per patient year of treatment.

The source of infection is breach in aseptic techniques, hematogenous or lymphatic dissemination of a septic focus.

The bacteriology include gram positive cocci ( Staph epidermidis, Staph aureus, Streptococci, enterococci) and gram negative bacilli(E.coli and Pseudomonas aeruginosa).

The clinical features are less severe, and predominant symptoms are diffuse abdominal pain, low grade fever, and associated with leukocytosis. The investigations show a cloudy and turbid dialysate with >100 neutrophils/$mm^3$ and positive culture of the peritoneal fluid.

The treatment is intraperitoneal administration of antibiotics. First start with broad spectrum antibiotics and if necessary change to appropriate antibiotics according to culture and sensitivity. According to International Society of Peritoneal Dialysis (ISPD), the recommendations are first generation cephalosporin for G+ve organism, third generation cephalosporin for G-ve organism and combination of both first and third generation cephalosporin, if no organism is identified. Aminoglycoside can be added if the residual urine output < $100cm^3$/day. The recommendations says heparin should be used to reduce the fibrin formation. The indication for termination of CAPD are persistence of peritonitis after 4-5 days of antibiotic usage, presence of fungal or tuberculous peritonitis, fecal peritonitis and presence of skin infection at catheter site.

## PERITONITIS IN IMMUNOCOMPROMISED INDIVIDUAL

The causes are AIDS and use of immunosuppressant therapy cancer, autoimmune disease and after organ transplantation surgeries. The most important cause of abdominal pain in AIDS patients is perforation of small bowel or colon secondary to Cytomegalovirus enteritis. Other organisms causing peritonitis in HIV patients are Mycobacterium avium-intracellulare, M. Tuberculosis, Cryptococcus neoformans, Strongyloides spp., and Leishmania spp.

The clinical features are similar to secondary peritonitis and the predominant symptom is severe abdominal pain. The treatment include intravenous fluids, broad spectrum antibiotics and emergency laparotomy with resection of the involved bowel.

## FAECAL PERITONITIS

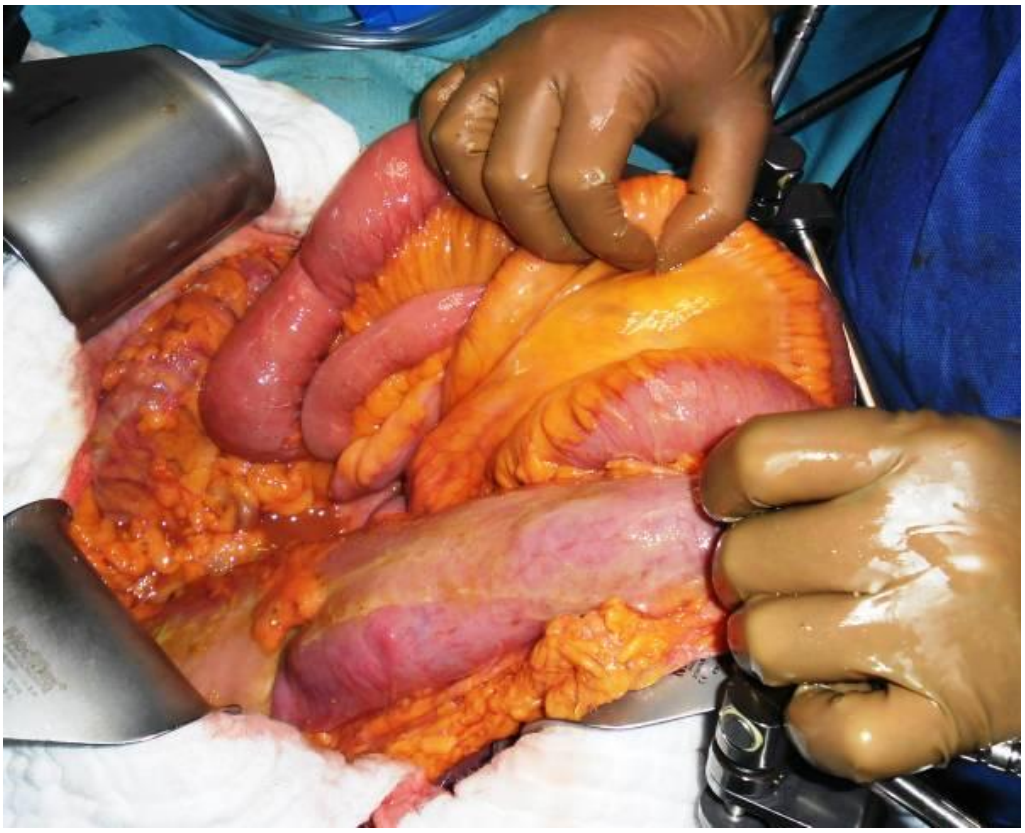
The clinical sequelae of free contamination of the peritoneal cavity with faecal material  differs from other forms of peritonitis in magnitude and speed of systemic disturbance.

**Causes**

1. Perforated diverticular disease
2. Anastomotic failure
3. Stercoral perforation
4. Perforation of a “threatened caecum”

   -left sided obstruction

   - pseudoobstruction
5. Perforated toxic megacolon
6. Trauma.



The operative management include generous access, remove particulate matter, generous lavage, and identify source. The source control include resection or exteriorisation of the perforation, Hartmann's procedure, or end ileostomy. Primary anastomosis should be avoided. Occasionally drainage, lavage, and proximal diversion can be done.

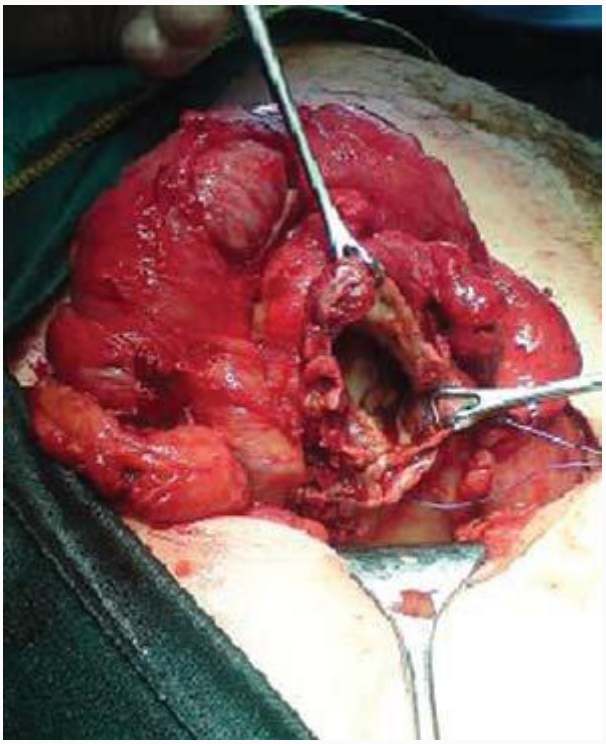
## APPENDICULAR PERFORATION

Appendicitis perforations, commonly occur at the tip of the appendix, are associated with the presence of a faecolith on CT scan and not the anatomical location of the appendix (retrocaecal appendix) as previously thought . Perforation of caecum is an uncommon differential diagnosis for an acute appendicitis. Other possible causes of caecal perforation include perforated right diverticulitis , caecal tumor, and rarely associated with foreign body , in burns patient , tuberculosis infection and following caesarean section or iatrogenic endoscopic procedure had been reported. Surgery for colonic perforation is associated with high morbidity and mortality rates.

While omental patch repair is a common surgical approach to management of stomach and duodenum perforation, there are only few reports in the literature that compare two very different surgical

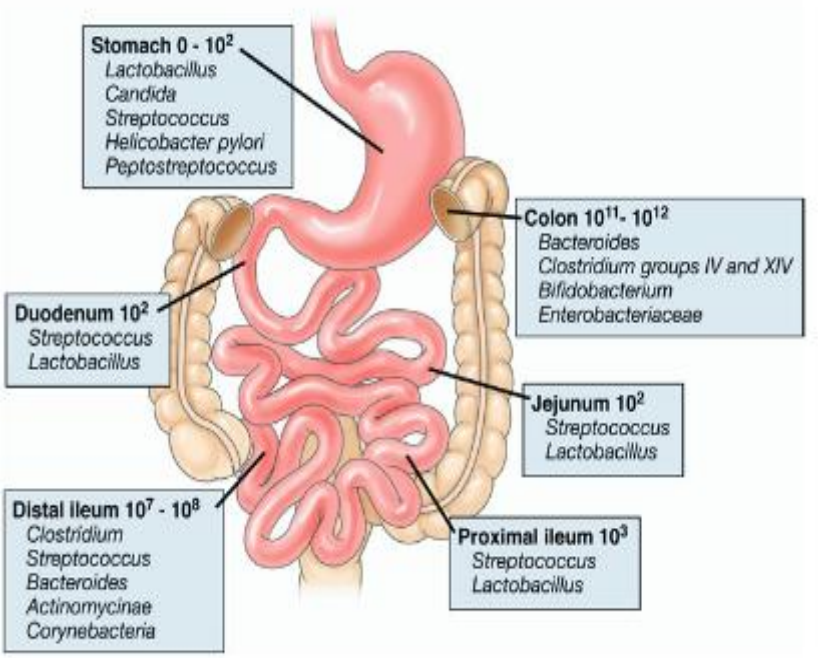
approaches - omental patch with primary repair vs right hemicolectomy. In the presence of an uncomplicated perforation, absence of severe infection, and well controlled localized hemostasis - a less invasive surgical approach with post operative intravenous antibiotics would be the management of choice.

Right hemicolectomy carries a higher morbidity and mortality but it is generally recommended only in selected cases - severe inflammation, torsion, haemorrhage, and inflammatory mass or caecal neoplasm found intraoperatively. The presence of severe appendicitis; or caecum appears necrotic in some cases warrants right hemicolectomy to be performed.



BACTERIA ENTER PERITONIUM BY-

1. TRANSMURAL INFLAMMATION IN LUMINAL OBSTRUCTION,
2. PERFORATION,
3. ISCHEMIA.(1)




**Microbial flora of the gut**

**FLORA IN GIT**

1. ANAEROBES (Bacteroides fragilis & clostridium)- 15%
2. AEROBES (Escherichia coli and enterococci) -10%
3. MIXED AEROBES AND ANAEROBES- 75%.

PATHOGENS IN ASCITIC FLUID INFECTION

Table (25)

| Organism | SBP | SECONDARY PERITONITIS |
|---|---|---|
| **Monomicrobial** | | |
| Escherichia coli | 37 | 20 |
| Klebsiella pneumonia | 17 | 7 |
| Streptococcus pneumonia | 12 | 0 |
| Streptococcus viridians | 9 | 0 |
| Staphylococcus aureus | 0 | 13 |
| Miscellaneous grem-ve | 10 | 7 |
| Miscellaneous gram+ve | 14 | 0 |
| **Polymicrobial** | 1 | 53 |

## DRAINAGE PATTERNS

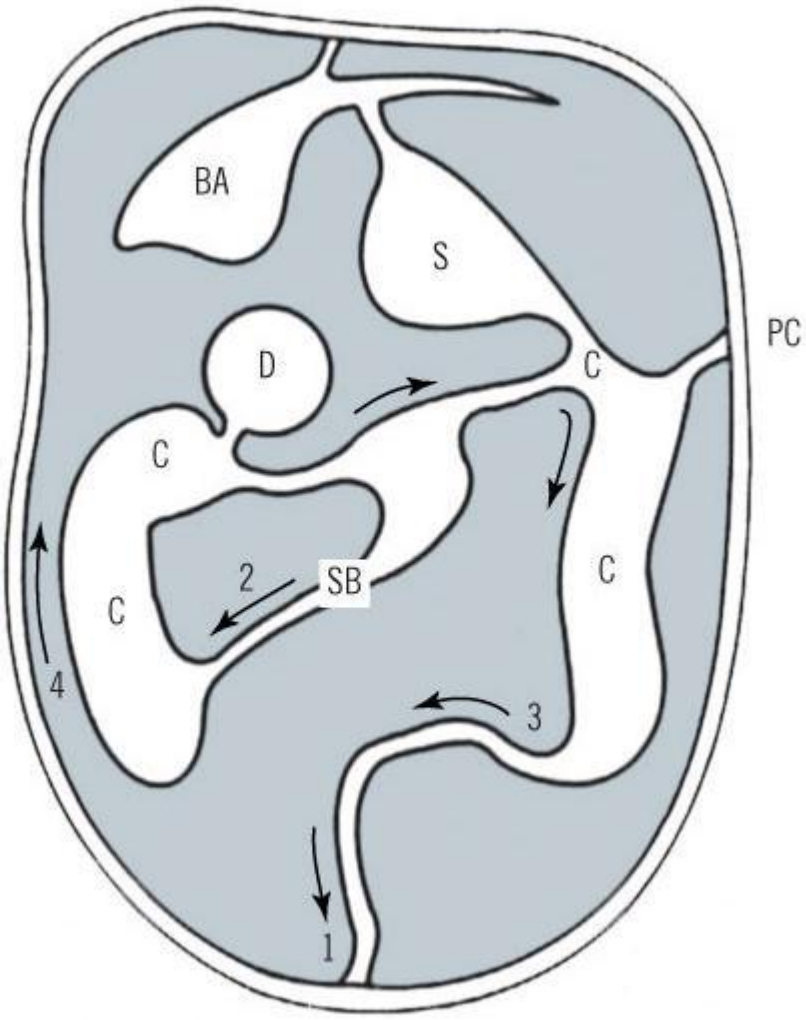
Spread of fluid in the peritoneal cavity depends upon

1. location of source & rate of fluid production

2. pressure difference in abdomen

3. mesenteric partitions & peritoneal fossae

4. position of the body in relation to gravity



Most common site of fluid collection is pouch of Douglas – the most dependent part of peritoneum The mesentery of small intestine & sigmoid mesocolon form barriers at which ascitic fluid may accumulate before spilling to pelvis

**CHIEF SITES OF FLUID COLLECTION IN ORDER OF FREQUENCY:**

1. Pouch of Douglas;
2. Distal attachment of mesentery;
3. Attachment of sigmoid mesocolon;
4. Right paracolic gutter.

**PERITONEAL CLEARENCE OF BACTERIA**

Peritoneum can clear bacteria within minutes conversely it may rapidly transport bacteria into systemic circulation via diaphragmatic lymphatics. 30% of total lymphatic drainage of the peritoneum is by diaphragm & rest through the parietal peritoneum. Abscess formation occurs as a last defense mechanism, when the cellular, humoral and clearance defense mechanisms are overwhelmed.

## I. DIAPHRAGMATIC LYMPHATICS-

Passage through diaphragm to thoracic duct.Bacteria can be seen in the thoracic duct in 6 min & blood in 30 min demonstrates the clearance mechanisms of diaphragm. Over the diaphragm the usual smooth flat layer of cells are interrupted by a large number of inter cellular gaps called **Stomata**(as named by VonReckling Hausen).These act as entrance to diaphragmatic lymphatic channels called **LACUNAE.** These lacunae are oriented parallel to muscle fibers of diaphragm and contain valves that prevent reflux of fluid back into abdomen, ultimately draining into substernal lymph nodes & then to thoracic duct.

**Factors influencing uptake**

1. Mesothelial cell processes usually occurs in a contracted state, when relaxes the size of stomata increases.
2. During inspiration diaphragm contracts and constriction of stomata occurs. During expiration diaphragm relaxes leading to opening of stomata, fluid and particulate matter gets sucked in.
3. Inflammation also increases stomata patency by inducing mesothelial cell retraction.

II. In a healthy individual the peritoneal cavity contains approximately 15 -50 mL of fluid with about 6 x 105 cells/ml (10). The functions of macrophages are recognition, phagocytosis and killing and participation in the immune response. Opsonins like complement C3b, immunoglobin G, fibronectin & leukotrienes coat bacteria and make them foreign. ICAM- 1 and VCAM-1 expressed by mesothelial cells causes macrophage and neutrophil migration to infective area. Opsonized microorganisms are recognized by specific receptors on the phagocyte. Macrophages of significant percentage are also found in the submesothelial interstitium. (26)

III. Sequestration mechanism are fibrin trapping, fibrin adhesion and omental covering of infection. Fibroblasts are the signalling molecules for the recruitment of bone marrow derived cells to the site of infection and acts as sentinel cells that combine structural and immunomodulatory function. The HPFBs (human peritoneal fibroblasts) are efficient signalling cells triggering the influx of neutrophils into the peritoneum while the HPFB-derived chemokines subsequently causes a gradual shift toward mononuclear cell chemo attractants.

Secrete plasminogen activator

|

Decrease in the fibrinolytic activity

|

Formation of fibrin adhesions

|

Initially helps in localizing the inflammation

**SUMMARY OF PERITONEAL RESPONSE TO INFECTION:**

1. The diaphragmatic stomata and lymphatics form the first line of defense against the bacteria in the abdominal cavity .

2. The macrophages in the peritoneum release chemokines that helps in the transmigration of neutrophils into the peritoneal cavity from the circulation.

3. The mast cells in the peritoneum undergo degranulation releasing histamine and other mediators, causing intense vasodilatation and the exudation of protein-rich fluid containing complement and immunoglobulins into the peritoneal cavity.

4. Proteins opsonizes bacteria, and also activates the complement components, promoting neutrophil- and macrophage-mediated phagocytosis and extinction

5. sequestration of bacteria within fibrin matrices, leading to abscess formation and thereby preventing generalised peritonitis.

**SEPSIS**

"Sepsis is one of the most common causes of morbidity and mortality in the intensive care unit". Sepsis related criteria include:

- Pyrexia <36ºC or >38ºC,
- Leukocytosis > 12000cells/$mm^3$ or Leukopenia <4000 cells/$mm^{3,}$
- Tachycardia >90/min and tachypnoea,
- Falling platelet count,
- Raising C-reactive protein,
- Increased insulin requirements to maintain normoglycemia,
- Elevated procalcitonin,
- Metabolic acidosis

These criteria are discussed in the ‘Surviving Sepsis’ guidelines. These guidelines are the product of a consensus conference devoted to the diagnosis and treatment of sepsis.

**HISTORY & PHYSICAL EXAMINATION**

Abdominal pain-character, site, radiation, change over time, aggravating & relieving factors(27),

Nausea, Vomiting(ileus),

Abdominal movements absent (pain),

High fever >100$^{\circ}$F (host defense) ,

Hypovolemia signs- tachycardia, dry mucus membrane, and hypotension,

Absent liver dullness,

Board like abdomen rigidity,

Involuntary guarding,

Rebound tenderness,

Absent bowel sounds,

Rectal and pelvic examination

**SYMPTOMS & SIGNS OF ASCITIC FLUID INFECTION-**

**SIGNS AND SYMPTOMS OF PERITONITIS ( FREQUENCY %)**

| Symptom or sign | SBP | Secondary perionitis |
|---|---|---|
| Fever | 68 | 33 |
| Abdominal pain | 49 | 67 |
| Abdominal tenderness | 39 | 50 |
| Rebound tenderness | 10 | 17 |
| Altered mental status | 54 | 33 |

**INVESTIGATIONS:**

1. TOTAL BLOOD COUNT-

Leukocytosis with juvenile form,

Leukopenia ( gram-ve sepsis, bone marrow failure),

2. ABG-

Metabolic acidosis, hemoconcentration & prerenal uremia,

3. SEPSIS BIOMARKERS-

Sepsis biomarkers include adrenomedullin (ADM) and pro-ADM, atrial natriuretic peptide (ANP) and pro-ANP , eosinophil count, interferon-g (IFN-g),and various interleukins(ILs), procalcitonin (PCT), pro-vasopressin(copeptin), resistin and triggering receptor expressed on myeloid cells 1 (TREM-1),

4. CXR-

CXR shows air under diaphragm(28)

Fig-

5. USG abdomen-

It shows any abscess,bile duct dilation and fluid collection

6. CECT ABD & PELVIS-

CECT is the sensitive & specific investigation. It is able to diagnose free air and site of perforation(28). Also the non specific findings in bowel perforation like phlegmon, abscess, or free fluid can be picked up in CT imaging(29). But it is not a must investigations.CT and peritoneal lavage is used to confirm the doubtful diagnosis.

7. Diagnostic laproscopy.

**MANAGEMENT OF PERITONITIS**

"Early diagnosis with prompt surgical intervention and aggressive preoperative and postoperative management is essential to reduce the morbidity and mortality from multiorgan system failure resulting from untreated peritonitis (30,31,32,33)".

As soon as diagnosis is made, immediate fluid resustication and antibiotic therapy started, patient should be prepared for laprotomy or laproscopy. Adequate fluid resustication is monitored by blood pressure,

heart rate, urine output, central venous pressure and pulmonary capillary wedge pressure measurement.

| Treatment for acute infective peritonitis |
| --- |
| General Resustication<br>Improve blood volume<br>Electrolyte balance<br>Supplement $O_2$<br>Monitoring (eg., vital signs, urine output, CVP, PCWP) |
| Broad spectrum Antimicrobial Therapy |
| Surgical management<br>Clearance of infective focus<br>Irrigation of the peritoneal cavity<br>Reoperation if focus of infection is not under control |
| Additional therapies under research<br>Administration of biological response modifiers, vaccination<br>Administration of antiendotoxin antibody<br>Cytokine antagonism, inhibition of prostaglandin synthesis |

Antibiotics should cover gram-ve aerobes and anaerobes. Multiple drug regimens either single or combinatorial are recommended, with comparable efficacy, by the Surgical Infection Society for treating intra-abdominal infections(34). Single broad spectrum antibiotics like betalactams, fluoroquinolones, third or fourth generation cephalosporins are adequate, routine use of nephrotoxic aminoglycoside not indicated base on recent cochrane review(35). The use of antifungal drugs against candida infection is indicated only in septic shock and immunocompromised patients.

Nosocomial infection due to multiresistant Pseudomonas, Enterobacter, Enterococcus, Staphylococcus and Candida species can occur due to long hospital stay. When patient develop MODS after surgery, thorough search for missed source or abscess, by repeating CT, followed by abscess drainage by percuaneous or operative, fluid culture and appropriate antibiotics are to be done(36).

## SURGERY

Antibiotics cannot cure the leaking gut or sterilize the abscess, so surgery is the treatment of choice, should be initiated when patient became hemodynamically stable. The aim of surgery are elimination of source, peritoneal lavage and prevent reinfection.

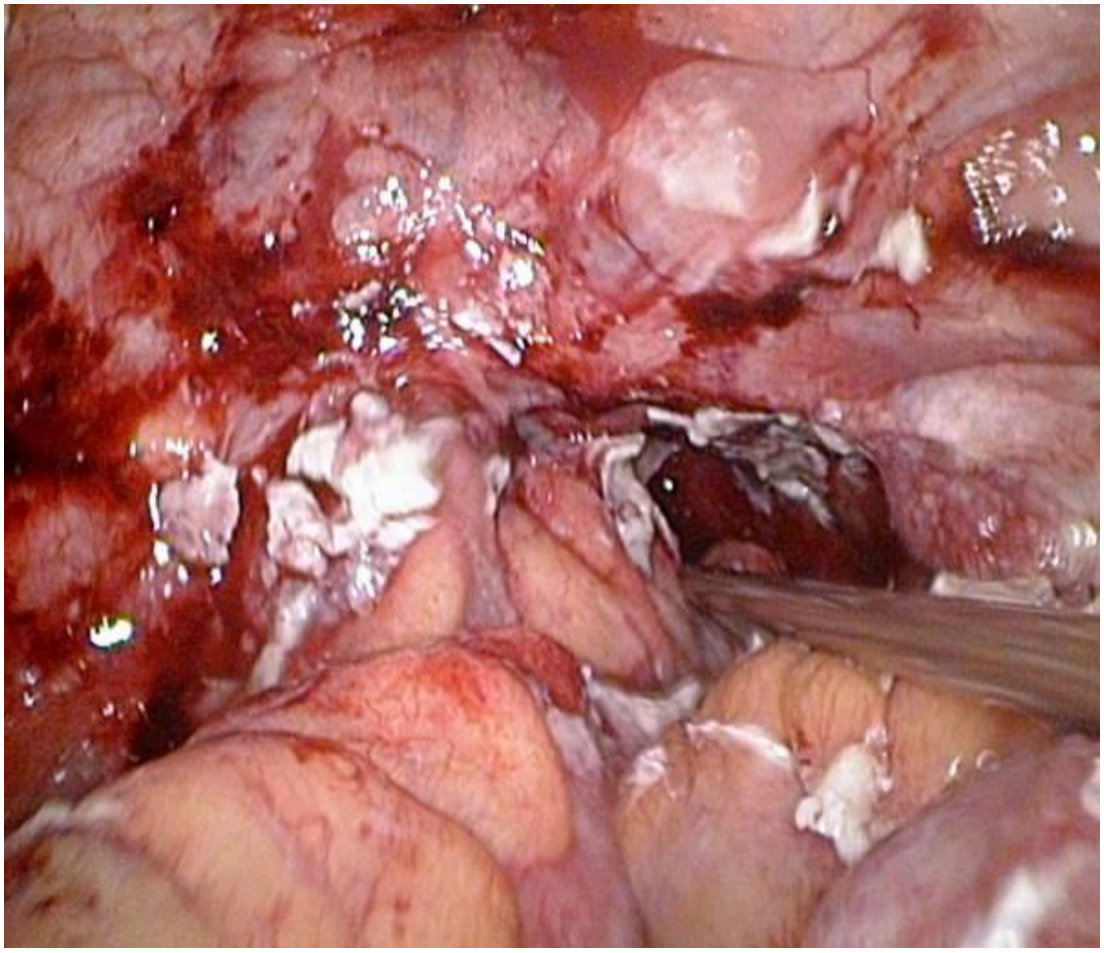
Expert surgical treatment forms the mainstay of treatment(37). Once the general condition of the patient is stabilised, laparotomy must be done to wash the peritoneal cavity copiously and also for closure of the perforation. If the infective focus is not cleared, debridement is partial, or definite abdominal closure is questionable, laparotomy in multiple stages may be needed for debridement, removal of abdominal packs, and repeated washing irrigation till the focus of infection is brought under control and abdominal closure is achieved. Placement of large abdominal zipper will be of great help for repeated opening of the abdomen .

## LAPAROSCOPY vs LAPAROTOMY

Surgical options are laparotomy and laparoscopy. The presence of peritonitis has previously been considered to be a contraindication for the laparoscopic approach because of the theoretical risk of malignant hypercapnia and toxic shock syndrome.

Laparoscopy (LAPS) is becoming the preferred surgical approach to different pathologies due to the possibility of correctly diagnosing and treating them at one time. There are undoubted advantages for patients thanks to this "gentle" and minimally invasive surgery, if compared to the open approach . Especially if we take in consideration "emergency" abdominal situations, where both critical component of operative treatment (exploration to identify the causative pathology and

performance of an appropriate operation) can often be "gently" accomplished laparoscopically.



Laparoscopy is feasible and safe in cases of peritonitis. Laparoscopic treatment is particularly effective in the case of appendicular and gastroduodenal perforation. In the case of colonic perforation, the conversion rate remains high but with growing experience and surgical skill, more of these cases will be treated laparoscopically in the future.

Laparoscopy is superior than laprotomy, because less inflammation due to small incision, less cytokines release, then less SIRS and less pain, early mobilization and less respiratory compromise(38-41).

RESURGERY IS INDICATED IN-

1. Acute abdomen / abdominal tenderness,
2. Wound infection,
3. Enteric contents leaking from a drain or through wound,
4. Prolonged ileus,
5. Abdominal pain or distension,
6. Failure to progress.

POST-OPERATIVE CARE-

Fluid and nutritional support should be initiated. Antibiotics should be continued & change of antibiotics based on culture report. Maintain a positive nitrogen balance preferably by enteral feeding using feeding jejunostomy.

PROGNOSIS

Mortality rate for secondary peritonitis is 14%, low for appendicitis and perforated duodenal ulcer(10%) and high for tertiary peritonitis(50%).

**JABALPUR PROGNOSTIC SCORE**

For the study, the authors performed a search of the PubMed database to identify studies on PPU patients and related outcomes. They found several studies that used various methods of analysis (receiver operating characteristics curve, area under the curve, etc) to compare a dozen scoring systems that predicts outcomes in these patients:

- “Boey score
- Hacettepe score
- Jabalpur score
- Peptic ulcer perforation (PULP) score
- ASA score
- Charlson comorbidity index
- Sepsis score
- Mannheim Peritonitis Index (MPI)

- Acute physiology and chronic health evaluation II (APACHE II)
- Simplified acute physiology score II (SAPS II)
- Mortality probability models II (MPM II)
- Physiological and Operative Severity Score for Enumeration of Mortality and Morbidity (POSSUM score)".

The Boey, Jabalpur, Hacettepe, and PULP scores were developed specifically for predicting outcomes in PPU patients; the others have been applied to PPU patients with varying degrees of success.

The APACHE- II and MPI are used in risk stratification of patients with perforated peptic ulcer(42-44). Complexity of these scoring systems has promoted attempts at simplification of prognostic methods. Most studies have found age, co-morbid illness, perforation to operation duration, female gender, pre-operative shock, heart rate, serum creatinine, hemoglobin level and chronic ulcer history as a factor that predict outcome (45-54). This has led to development of simpler prognostic scoring systems, including Boey et al which included only three variables ( preoperative shock, presence of co-existing medical illness, and perforation duration >48 hours), and the Hacettepe score by Altaca et

al which used four variables ( acute renal failure, leukocyte count >20 $*10^9$/L, male gender and presence of co-existing medical illness).

None of the patients have this high leukocyte count, thus one of the 4 values of hacettepe score is not applicable. Use of BOEY score showed mortality rate with poor prognostic factors was 44% compared to the predicted rate of 100%. Not much difference in mortality was found in patients with perforation operation interval of 0-24 hours and 25-72 hours, but the mortality rate increased progressively thereafter.

JPS uses six clinical factors, all of which are routinely documented and can be assessed objectively. It predicts both morbidity and mortality, and can be assessed soon after hospital admission. The predicted and observed outcome with his score match well. Behaviour of the score at cut-off point is predictable. Its accuracy, sensitivity, specificity and predictive power are at par with, if not better than, other commonly used scoring systems(55).

The APACHE II score may be considered the " gold standard" , having been evaluated in thousands of patients all over the world(56). However complexity of APACHE II and its dependence on sophisticated investigation have prevented its wider use in developing countries.

The Jabalpur scoring system is useful because perforation-to-operation interval is often prolonged in developing countries, which is a part of this scoring system. Further all the measures used in this scoring systems are simple aiding objectivity in data collection and consistency. It is applicable in all developing countries where ICU facilities and sophisticated investigations are lacking.

In conclusion, Jabalpur scoring system can predict both morbidity and death, simple, easier , and applicable even in small hospitals in developing countries.

**JABALPUR PROGNOSTIC SCORE:**

| FACTOR | SCORE | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| AGE(years) | <45 | | 45-54 | 55-64 | | 65-74 | >75 |
| PO INTERVAL (hours) | <24 | 24-72 | 73-96 | 97-120 | >120 | - | - |
| Heart Rate/min | 70-109 | - | 110-139 or 55-69 | 140-179 or 40-54 | <39 or >180 | - | - |
| Mean Blood pressure (mmHG) | 70-109 | - | 110-129 or 50-69 | 130-159 | <49 or >160 | - | - |
| Creatinine (mg/dL) | 0.6-1.4 | - | 1.5-1.9 | 2.0-3.4 | >3.5 | - | - |

PO interval:perforation operation interval

If Comorbid diseases positive , add 5 and none if not (Definition of comorbid illness is according to APACHE II scoring system).

Total Score = Age score + PO interval score + Heart rate score + Mean BP score + Creatinine score.

Maximum possible score is 27

**ABSOLUTE EOSINOPHIL COUNT**

"Eosinophils were first detected in peripheral blood in the year 1865 by Max Schultze.(57) A specific stain for staining the granules was described by Ehrlich P. in 1879(58)".

"By 1888 observers were studying differential counts of leukocytes. During this period Mayet described his eosin-glycerine method. It was in 1910 that Dunger(59) established the eosinophil counting method using the counting chamber".

The cellular elements of the blood are produced from common multipotential hematopoietic cells. This cell undergo mitotic division and maturation to form cellular elements of the blood, namely the erythrocytes, leukocytes and thrombocytes.

On the basis of function leukocytes are divided into the granulocytic, monocytic and lymphoid series. The granulocytic leukocytes are further subdivided on the basis of morphology into neutrophils, eosinophils and basophils.

MATURE FORMS OF GRANULOCYTES:

The granules are normally produced by rough endoplasmic reticulum and transported to golgi apparatus for packing. The band forms have a typical elongated nucleus. The segmented neutrophils has a characteristic multilobulated nucleus and contain antibacterial substances, including hydrolases, lyzozyme and myeloperoxidase.

The eosinophils are bilobed and differ from neutrophils in that they lack lysozyme. These granules are of two types:

1. Small round granules, which have been identified as not containing crystalloids. These granules exist in small quantities in mature eosinophils and rich in acid phosphatase.

2. Large crystalline granules, which are more numerous. These crystalline granules are elliptical, larger the granules of the neutrophil, and had an amorphous matrix surrounding an internal

crystalline structure. These crystals thought to represent the enzyme peroxidase and the matrix contains acid phosphatase.

Basophils contain heparin and histamine(60).

NORMAL VALUE OF GRANULOCYTE:

1. Neutrophils- 1.50- 7.50* $10^9$ /L (40-75%)
2. Eosinophils – 0.05 – 0.06 * $10^9$ /L(1-7%)
3. Basophils- 0.02 -0.05* $10^9$ /L( 0-2%)

**Pathogenesis in infection**

Infection with the microbe activates the defense mechanism where the cells of the immune system get access to the site of infection . This is followed by activation of the complement component C3b, which forms complex with the microbe. The neutrophil chemoattractant and activator C5a together with C3a and C4a causes degranulation of mast cells releasing histamine . Histamine release causes contraction of smooth muscles and rapid increase in vascularity.

The pro inflammatory mediators are released by the immune cells and also by the microbe and the damaged cells. These mediators

upregulate the expression of intercellular adhesion molecules on vascular endothelium, causing adhesion of the immune cells to the vascular endothelium(rolling). The L- selectin cell surface adhesion molecule on the neutrophils recognizes sialyl lewis residues on the vascular endothelium. This activates the neutrophil, followed by rapid shedding of the L-selectin from its surface and expresses another cell surface adhesion molecule (e.g, integrins). The inflammatory mediators ( e.g, bacterial lipopolysaccharide, and the cytokine, interlukin-1 and tumour necrosis factor α) stimulates those integrins to bind E-selectin on the vascular endothelium. Complement system and chemokines contribute to the recruitment of inflammatory cells.

Activated neutrophils transmigrate through the vessel wall to the site of infection where they phagocytose the C3b- coated microbes. Mutations in the genes coding various cell to cell adhesion molecules were found in leukocyte adhesion deficiencies, and this may be the reason for severe life threatening infections.

**Sepsis**

Neutrophils are double edged weapons. Although neutrophils are essential for the phagocytosis of pathogens , excessive release of

proteases and oxidants by these cells are responsible for the injury to various organs.

Early biochemical event in sepsis is the release of cytokines like TNF, Inerleukins. Of these TNF,IL-1,IL-8 are considered proinflammatory, whereas IL-6,IL-10 are antiinflammatory. Microbial toxin triggers the production of TNF and IL-1 which in turn promotes endothelial cell leukocyte adhesion followed by the release of proteases and arachidonate metabolites and activation of clotting.

**Eosinophils**

Eosinophils are considered as homeostatic regulators of inflammation. They leave the circulating blood when adrenal cortical hormone increases. Functionally this means that the eosinophils attempts to suppress inflammatory tissue reactions to prevent the excessive spread of inflammation.

Eosinophils proliferate in response to antigenic stimulation and contain substances that inactivate factors released by mast cells and basophils. The primary function of eosinophils appears to be their reactions with products from mast cells, lymphocytes, and other soluble

substances in the blood such as the clotting factors,complement components and hormones.

Although eosinophils are ineffective in protecting the body against invading foreign paricles, they do play a role in the defense mechanisms against infections. Eosinophils have the ability to interact with the larval stages of some helminthic parasites and damage them by means of oxidative mechanisms. Certain proteins released from eosinophilic granules are known to damage antibody coated Schistosoma parasites.

METHOD

The Dunger's solution which contains acetone, Eosin and distilled water.

Acetone 10 ml and aqueous eosin 0.1gm are the reagents that are mixed in equal quantity. The reconstituted stain should be used within 4 hours and there should be no precipitation . When viewed under microscope the eosinophilic granules stain red, while other leucocytes nuclei stained blue-green.

The determination of complete blood count is by manual counting. Although this is cost effective, this method increases the

work load and time consuming. The manual counting are now replaced by automation decreasing the turn around time to 80-120 haematology samples/hr, and 18-24 tests per sample are done with just 100 µ1 of blood.

## EOSINOPENIA AS A MARKER OF SEPSIS

The clinicians need sufficient tests to promptly diagnose sepsis as early diagnosis and treatment will significantly reduce the mortality and morbidity(61). An early diagnosis of septicemia without microbial culture would ensure early administration of antibiotic therapy this in turn reduce the patient mortality. Unfortunately, till now there is no marker of infection that satisfies the need as sensitive and specific marker(62,63). An ideal marker of infection should have increased sensitivity and specificity, easy methodology, short run time , cost effective, and should be in concordance with the severity and prognosis of infection.

It is well known fact that in acute infection/ inflammation there is rapid decrease in the number of circulating eosinophils [64]. ”This marked reduction in the number of circulating eosinophil leucocytes in acute infection was first described by Zappert in 1893 [65]”, and widely

used in the last century as a useful diagnostic sign [66]. This was followed later by the information that eosinopenia is part of the normal response to stress [67], it was said that eosinopenia in acute infection is a secondary response to stress induced by the infection [68].” The value of this old marker of acute infection was tested by Gil and colleagues(69)”.

Gold standard test for the identification of sepsis has not been identified so far; but Procalcitonin is found to play promising role in septicemia and it is found to complement clinical findings and lab test results in cases of septicemia [70-75]. The disadvantage of procalcitonin assay is its cost, and because of the high cost this test does not gain popularity in developing countries and it cannot done in our hospitals. Many studies show that the good old marker of sepsis, decreased absolute eosinophil count being cheaper performs equally well as procalcitonin in the diagnosis of sepsis.

Eosinopenia was used to identify septicaemia in this study. “The study by Gil and colleagues in a department of internal medicine showed that an inflammatory syndrome associated with an eosinophil count <40 cells/mm3 is related to bacterial infectious diseases. In an experimental

study, Bass and colleagues produced eosinopenia in rabbits and in humans using chemotactic factors of acute inflammation (76)".

"In trauma patients, however, Dipiro and colleagues found an increased eosinophil count after sepsis [77]. This eosinophil production was enhanced by IL-4 and IL-5, and suggests a T-helper lymphocyte type 2 cytokine activation in response to sepsis after traumatic injury".

Normally 1% to 3% of peripheral blood leucocytes are contributed by eosinophils, and the upper limit of absolute eosinophil count is 350 cells/mm3 blood [78]. The eosinophils level in our body are under regulation. In acute infection , eosinopenia, occurs as a response to stress, under the influence of corticosteroids and epinephrine. It was also explained that the eosinopenia was the result of recruitment of eosinophils in the circulation to the site of infection. This recruitment occurs as a result of chemokines produced by the immune cells, microbes and damaged tissue in acute infection. The main chemokines being C5a and fibrin fragments whose presence have been found in the circulation in acute inflammation [76].

Eosinopenia can be considered a better marker of sepsis than CRP, and an useful tool in intensive care setup(79).

## C-Reactive Protein(CRP)

In the year 1930,Tillet and Francis found a substance in the sera of seriously ill patients which was able to bind with the “C-polysaccharide of the cell wall of bacteria streptococcus pneumonia”(80) and cause agglutination. Later in 1940 the substance was found to be a protein and was named as C-Reactive Protein(CRP)(81).

C-Reactive Protein(CRP) is an acute phase protein which is essential for the host defence against inflammation particularly in infection.

## Biochemistry

C-Reactive Protein(CRP) is a disk shaped cyclic polymer made of five identical non glycosylated polypeptide subunits. It is of molecular weight 115 kDa. Synthesis takes place mainly in the liver, regulated by IL-6. It is capable of binding to cellwall polysaccharides of many bacteria, fungi, protozoal parasites and polycations like histones. Extra hepatic synthesis of CRP do occur in neurons, atherosclerotic plaques, monocytes and lymphocytes(82,83). The mechanisms by which extra hepatic synthesis occur remains unclear and they contribute less to the plasma levels of CRP.

**Synthesis and Metabolism**

CRP is synthesised by the liver cells in response to cytokines like IL-6. Glucocorticoids stimulate the cytokines which in turn stimulates the acute phase response(85). Insulin has an opposite effect(86). During infection or inflammation there is increased secretion of these proteins (87). During an acute phase response, the rate of increase is dependent on the duration of stimulation and the hepatic response(88).

Acute phase CRP values show no diurnal variation and are not affected by food. Liver cell failure decreases CRP production. No other pathologies or drugs affects acute phase CRP levels unless the disease process affects the pathway of synthesis.

CRP concentration is an useful but non specific biomarker of inflammation, measurement of which is useful in a. Screening for organic disease, b. monitoring response of infection and inflammation, c. detection of intercurrent infection in immunocompromised patients.

CRP gene

CRP gene is located in the short arm of chromosome 1.Induction of CRP synthesis by liver is controlled at the transcriptional level by

interleukins (IL-6 & IL-1b)(84). The interleukins control the expression through activation of the transcription factors STAT3,C/EBP, NF-κB.

**Function**

C-Reactive Protein(CRP) helps in nonspecific host defence against infection by forming a complex with tissue breakdown products. CRP binds to the phosphocholine ligand expressed on the surface of dead or dying cells or bacteria. These complexes activate the classic complement pathway resulting in phagocytosis via C3b receptors.

**Clinical Significance**

**Acute Phase Response**

C-Reactive Protein(CRP) is one of the most sensitive acute phase reactant in myocardial infarction, stress, trauma, infection, inflammation, surgery and neoplastic proliferation. The increase is more for bacterial than viral infections.

C-Reactive Protein(CRP) starts rising within 6 to 12 hours and peak levels are at 48hours.

**Reference Interval**

The reference interval for CRP in adults is < 5mg/L(89).

C-REACTIVE PROTEIN is elevated in(90)

| | |
|---|---|
| A. Acute inflammation:<br>➢ Bacterial infection<br>➢ Pneumococcal pneumonia<br>➢ Acute rheumatic fever<br>➢ Bacterial endocarditis<br>➢ Staphylococcal osteomyelitis<br><br>C. Tissue injury:<br>➢ Surgery<br>➢ Acute myocardial ischemia | B. Chronic inflammation:<br>➢ Systemic lupus erythematosis<br>➢ Rheumatic arthritis<br>➢ Reiter's syndrome, psoriatic arthropathy, arthritis following jejuno-ileal byepass<br>➢ Polyarteritis nodosa, disseminated<br>➢ Systemic vasculitis, cutaneous vasculitis<br>➢ Polymyalgia rheumatica<br>➢ Crohn's disease<br>➢ Ulcerative colitis<br>➢ Dermatomyositis<br>➢ Osteoarthritis<br>➢ Neoplastic diseases<br>➢ Smokers<br>➢ Obesity<br>➢ Diabetes |

## CRP and Ischemic heart Disease

The clinical relevance of CRP determination in subjects without clinically overt ischemic heart disease is still controversial. However,in a recent report of the Reykjavik Study, Danesh et al "Confirmed CRP is an independent predictor of coronary heart disease, but the CRP-associated odds ratio was lower than that of established cardiovascular risk factors such as systolic blood pressure, smoking, and total cholesterol"(91).

## CRP AND DIABETES

Type II DM is associated with increased risk of macrovascular complications, like ischemic heart disease, stroke, and peripheral vascular disease. These vascular complications occur as a result of atherosclerosis.

Hyperglycemia stimulates the production of cytokines like TNF and IL-6 . Hyperglycemia also induces the secretion of acute phase proteins by adipocytes. Chronic uncontrolled blood sugar is the principal factor in the pathogenesis of diabetic complications including atherosclerosis, dramatically increasing the release of cytokines(92).

## CRP AND METABOLIC SYNDROME

Metabolic syndrome is defined as "the presence of three or more of the following : abdominal obesity, elevated triglycerides, reduced levels

of HDL cholesterol, high blood pressure, and high fasting glucose". All these parameters may increase the serum levels of C-reactive protein. CRP levels also correlate with other components of the metabolic syndrome such as fasting insulin, microalbuminuria, and impaired fibrinolysis (93).

## METHODS OF DETERMINATION

The original test was a simple precipitin test in which the height of the precipitin determines the CRP level in blood. A comparison of reaction by different investigators gave disparate results depending on the anti serum used.

It was not until 1980 did a rapid and reliable immunoassay became available. Some investigators used immunoassays of direct visualisation of the antigen antibody reactions (Latex agglutination), While some others used precipitation assays (radial immunodiffusion, nephelometry, turbidimetry). The rest used immunoassays with a marker of detection (RIA, Enzyme multiplied immunoassay).

Although slide agglutination test is rapid and convenient, it is semiquantitative. Studies comparing these methods with fully automated

nephlometric and turbidimetric methods show superior precision, sensitivity and reproducibility.

However these assays have limited sensitivity that they could not detect CRP levels below 10 mg/dL. The satisfactory thing in this that the marked acute phase responses that characterise bacterial infections, ischemic necrosis tend to have higher CRP values.

Hs CRP:

High-sensitivity CRP (hs-CRP) is useful in detecting low levels of CRP using nephelometry. The sensitivity of the test is decreased down to 0.04 mg/L.

# AIM OF THE STUDY

The aim of the study are/were

1. Is decrease in Absolute eosinophil count a reliable prognostic marker in patients with perforative peritonitis?

2. Comparison of the efficiency of Absolute eosinophil count (AEC) with C-reactive protein(CRP) and Jabalpur prognostic Index in assessing the mortality in perforative peritonitis.

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# MATERIALS AND METHODS

The present study was done in this college between September 2013 to September 2014. Total of 104 patients with perforative peritonitis presented consecutively to this college were chosen. The study was approved by the Ethical Committee of Stanley Medical College.

## STUDY POPULATION

Subjects : 104 patients with perforative peritonitis presenting to this hospital

Age group: 15-90 years

### Inclusion criteria:

Patients with secondary bacterial peritonitis due to hollow viscous perforation (by clinical and radiological methods)

### Exclusion criteria:

Patients with

1. Spontaneous bacterial peritonitis
2. Malignant perforation, traumatic perforation
3. Non-resusticable patients

4. Post surgical leak.

## DIAGNOSIS

Diagnosis of peritonitis due to hollow viscous perforation was done by

- History and Clinical Examination
- X-ray chest PA view showing air under diaphragm
- USG abdomen showing free fluid in peritoneum
- CT SCAN

## MORTALITY

Mortality was defined as any death occurring during the hospital stay.

## MORBIDITY

Morbidity was defined in terms of post operative complications such as

1. Wound infection,
2. Intra abdominal collection,
3. Pneumonia or lung atelectasis,
4. Acute myocardial infarction or heart failure,
5. Acute renal failure and urinary tract infection.

Once the diagnosis of peritonitis was made, the patients were enrolled in the study. In addition to personal data such as name, age, sex other details like comorbid illness, perforation operation interval, heart rate, blood pressure were recorded. Blood samples were to be collected for determination of AEC, CRP and Creatinine.

**SAMPLE COLLECTION**

Blood samples were collected at the time of admission. 5mL of venous blood was collected in EDTA tube for the determination of Absolute Eosinophil Count(AEC) and 3 mL in Heparinised tube for C-Reactive Protein(CRP).

All patients were treated conventionally after stabilising their general condition.

**ABSOLUTE EOSINOPHIL COUNT**

The Absolute Eosinophil Count was determined in the Neubaeur counting chamber by counting the number of eosinophils per 100 white blood cells; It is then multiplied by the white blood cell count of the patient.

## C-REACTIVE PROTEIN

C-Reactive Protein was estimated using Latex Agglutination assay. The reagent was a suspension of polystyrene latex particles of uniform size coated with anti human CRP antibodies. Latex particles allow visualisation of the antigen antibody reaction. If C-reactive protein was increased in the serum, the reaction of the antigen with the antibody results in agglutination which is evident in the latex particles.

Results are expressed in mg/L of C-reactive protein based on the WHO International Standard for Human C-Reactive Protein.

## CREATININE

Serum creatinine was estimated using colorimetric principle by Jaffe's method. The creatinine present in the serum reacts with picric acid in alkaline medium to form reddish orange alkaline picrate. The determination of creatinine was done in AU480 analyser.

## JABALPUR PROGNOSTIC SCORE

The Jabalpur prognostic index was calculated based on the age, perforation operation interval, heart rate, mean arterial pressure, serum creatinine values.

Perforation operation interval was calculated based on the time interval between the onset of symptoms and time of presentation to this hospital.

Heart rate was counted for 1 min and expressed as beats/min.

Mean arterial pressure was calculated based on the formula (Systolic BP+ 2Diastolic BP)/3.

The patients were followed postoperatively for their duration of stay in the hospital, any morbidity or mortality. Survival or inpatient mortality was considered as the end point of this study.

Based on the post operative mortality details these patients were classified into two groups: mortality group and survival group. Absolute Eosinophil Count, C-Reactive Protein and Jabalpur Prognostic Index were compared between the two groups.

# STATISTICAL ANALYSIS

Data were processed using SPSS software. All values were expressed as mean ± Standard deviation / median.

- Comparison of Jabalpur prognostic index, absolute eosinophil count and CRP between the two groups was done using student 't' test.
- Prognostic accuracy of the parameters were done using ROC curve analysis

# RESULTS

104 patients with perforative peritonitis(86 male) were chosen and were allocated into two groups based on the outcome as mortality or survival. 88 patients were in the survival group and 16 patients were in the mortality group. Age group of the patients ranged from 24 to 75 years. The characteristics of the patients like age, heart rate, mean blood pressure, perforation operation interval, serum creatinine, AEC, CRP, JPS are tabulated.

**Table no.1 Characteristics of patients in the survival group**

| PARAMETER | MEAN ± SD | RANGE | 95% CI | MEDIAN |
|---|---|---|---|---|
| AGE (YEARS) | 48.24 ± 12.03 | 24-75 | 45.69 – 50.79 | 48 |
| M:F | 76 :12 | | | |
| PERFORATION OPERATION INTERVAL(HOURS) | 68 ± 18.81 | 22-110 | 64.01 - 71.99 | 73.5 |
| MEANBLOOD PRESSURE(mmHg) | 81.46 ± 11.03 | 60-110 | 79.12 – 83.79 | 80 |
| HEART RATE(/min) | 111 ± 10.62 | 88-135 | 108.78 – 113.29 | 111 |
| CREATININE(mg/dL) | 1.19 ± 0.33 | 0.5-2.4 | 1.12 – 1.26 | 1.2 |
| COMORBID ILLNESS | 3/88 | | | |
| AEC(cells/cu.mm) | 168.64± 34.84 | 107-242 | 161.25 – 176.02 | 164.5 |
| CRP(mg/dL) | 35.43 ± 15.22 | 5-79 | 32.21 – 38.66 | 35 |
| JPS | 5.14 ± 1.66 | 1-9 | 4.78 – 5. | 5 |

Table.1 showing the characteristics of the patients in the survival group. The age, perforation operation interval, heart rate, mean blood pressure, serum creatinine ,AEC, CRP, JPS values were expressed as mean ± SD. Their median values and range of distribution were also given.

**Table no.2 Characteristics of patients in the mortality group**

| PARAMETER | MEAN ± SD | RANGE | 95% CI | MEDIAN |
|---|---|---|---|---|
| AGE (YEARS) | 53.75 ± 8.68 | 34 - 66 | 49.12 - 58.38 | 55 |
| M:F | 10 : 6 | | | |
| PERFORATION OPERATION INTERVAL(HOURS) | 91.81 ± 25.04 | 40 - 135 | 78.47 - 105.15 | 90 |
| MEAN BLOOD PRESSURE(mmHg) | 64.03 ± 13.45 | 46 – 85 | 58.87 - 71.20 | 64 |
| HEART RATE(/min) | 134 ± 7.31 | 122 -145 | 130.10 - 137.90 | 134.5 |
| CREATININE(mg/dL) | 2.03 ± 0.55 | 1-3.2 | 1.73 -2.32 | 1.9 |
| CO MORBID ILLNESS | 4/16 | | | |
| AEC(cells/cu.mm) | 33.13 ± 7.50 | 23 -45 | 29.13 - 37.12 | 32 |
| CRP(mg/dL) | 89.75 ± 15.70 | 58 -110 | 81.39 - 98.11 | 92 |
| JPS | 12.50 ± 2.50 | 9 -18 | 11.17 - 13.85 | 11.5 |

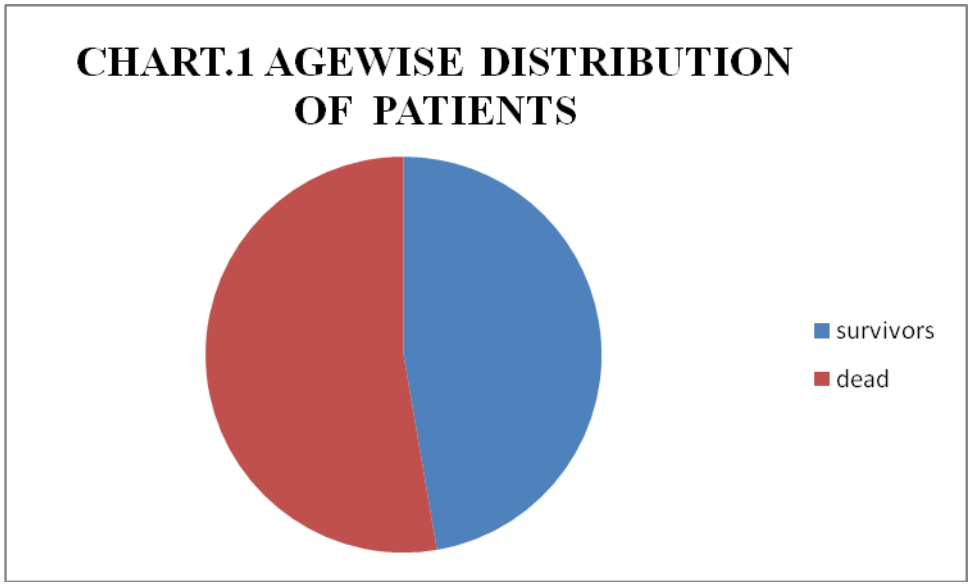


**CHART.2 SEXWISE DISTRIBUTION OF PATIENTS**

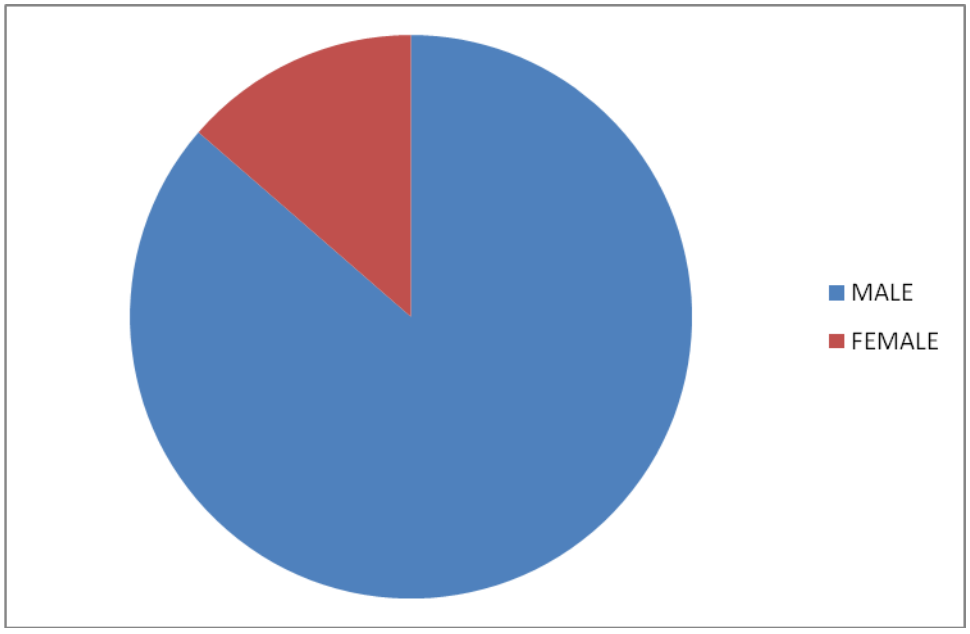

Table.2 showing the characteristics of the patients in the mortality group. The age, perforation operation interval, heart rate, mean blood pressure, serum creatinine ,AEC, CRP, JPS values were expressed as mean ± SD. Their median values and range of distribution were also given.

**Table no.3 Age and vital parameters distribution in the survival and mortality groups**

| Parameters | | Mean ± SD | T | P |
|---|---|---|---|---|
| Age | Survivors | 48.24 ± 12.03 | 1.74 | 0.08 |
| | Dead | 53.75 ± 8.68 | | |
| Heart rate | Survivors | 111.03 ± 10.62 | 8.28 | 0.0001* |
| | Dead | 134 ± 7.31 | | |
| Mean blood pressure | Survivors | 81.45 ± 11.03 | 5.62 | 0.0001* |
| | Dead | 64.03 ± 13.45 | | |
| Perforation operation interval | Survivors | 68 ± 18.81 | 4.41 | 0.0001* |
| | Dead | 91.81 ± 25.04 | | |

Table.3 showing comparison of age, heart rate, mean blood pressure and perforation operation interval between the two groups. There was no significant difference with respect to age between the two groups. But heart rate mean blood pressure, perforation operation interval differ significantly between the two groups. This shows that perforation operation interval affects the outcome of the disease. p value <0.05 was considered significant.

**Table no.4 Distribution of ACE, CRP, JPS and Creatinine among the patients**

| Parameters | | Mean ± SD | T | P |
|---|---|---|---|---|
| Creatinine | Survivors | 1.19 ± 0.33 | 8.25 | 0.0001* |
| | Dead | 2.03 ± 0.55 | | |
| AEC | Survivors | 168.64 ± 34.84 | 15.43 | 0.0001* |
| | Dead | 33.13 ± 7.50 | | |
| CRP | Survivors | 35.43 ± 15.22 | 13.07 | 0.0001* |
| | Dead | 89.75 ± 15.70 | | |
| JPS | Survivors | 5.14 ± 1.66 | 14.96 | 0.0001* |
| | Dead | 12.50 ± 2.50 | | |

Table.4 showing serum creatinine, AEC,CRP and JPS distribution between the two groups. There was statistically significant difference in creatinine, AEC ,CRP levels and JPS between the two groups. This shows that decrease in AEC,and increase in CRP and JPS were associated with adverse outcome in perforative peritonitis patients. P value < 0.05 was considered statistically significant.

**CHART.3 AEC,CRP AND JPS LEVELS BETWEEN SURVIVORS AND DEAD**

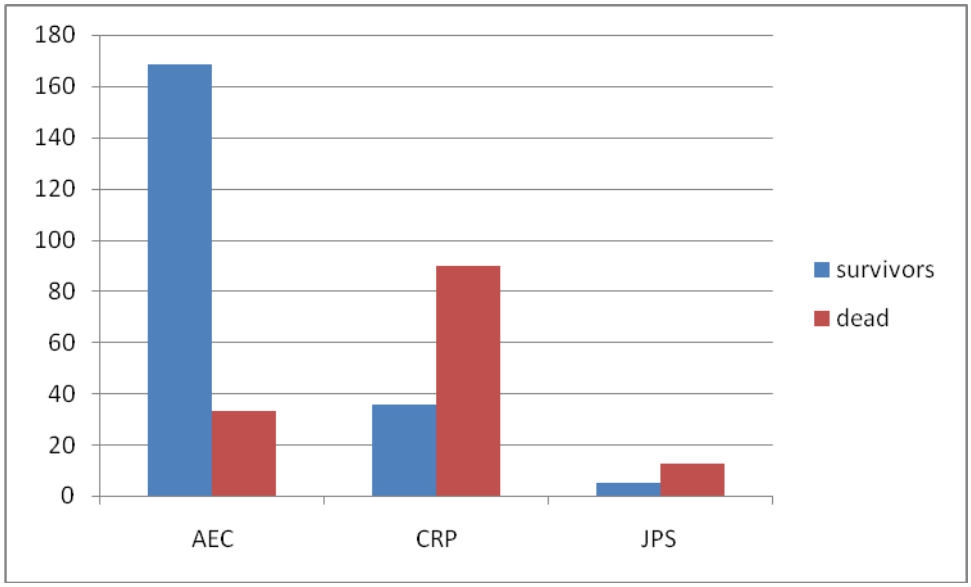

**Table no.5 Causes of perforation and their AEC, CRP and JPS values.**

| Perforation | n | No of deaths (%) | AEC | | CRP | | JPS | |
|---|---|---|---|---|---|---|---|---|
| | | | Mean ± SD | Range | Mean ± SD | Range | Mean ± SD | Range |
| Peptic | 55 | 10 (18.2 %) | 141.89 ± 59.98 | 23-240 | 45.13 ± 25.92 | 10-100 | 6.38 ± 3.10 | 1-15 |
| Ileal | 41 | 6 (14.6 %) | 148.54 ± 59.26 | 28-242 | 42.66 ± 24.76 | 5- 108 | 6.29 ± 3.63 | 1-18 |
| Appendicular | 5 | 0 | 187.20 ± 38.29 | 143-239 | 39 ± 25.58 | 11-79 | 4.80 ± 1.30 | 4-7 |
| Colonic | 3 | 0 | 180 ± 28.79 | 147-200 | 42.67 ± 8.02 | 35- 51 | 6.33 ±1.53 | 5-8 |

Table.5 showing the types of perforation and the distribution of AEC, CRP and JPS values. Out of the 55 patients with peptic perforation, 10 died(18.2%) and of the 41 patients with ileal perforation 6 died(14.6%). The AEC, CRP and JPS values of the various types of perforation were given as mean ± SD.

**Table no.6 Comparison of AEC, CRP and JPS with the type of perforation**

| Type of perforation | N (%) | AEC | | CRP | | JPS | |
|---|---|---|---|---|---|---|---|
| | | Mean ± SD | p | Mean ± SD | p | Mean ± SD | P |
| Peptic | 55 (53%) | 141.89 ± 59.98 | 0.28 | 45.13 ± 25.92 | 0.56 | 6.38 ± 3.10 | 0.70 |
| Ileal | 41 (39%) | 148.54 ± 59.26 | 0.92 | 42.66 ± 24.76 | 0.71 | 6.29 ± 3.13 | 0.95 |
| Appendicular | 5 (5%) | 187.20 ± 38.29 | 0.12 | 39 ± 25.58 | 0.66 | 4.80 ± 1.30 | 0.30 |
| Colonic | 3 (3%) | 180 ± 28.79 | 0.33 | 42.67 ± 8.02 | 0.94 | 6.33 ± 1.53 | 0.97 |

Table.6 shows the comparison of the type of perforation and their AEC, CRP and JPS levels. Peptic(53%) perforations were commonest(first part of duodenum and prepyloric) followed by ileal(39%), appendicular(5%) and colonic(3%) forms. There was no statistically significant difference in AEC, CRP and JPS levels with respect to the type of perforation. P value < 0.05 was considered statistically significant.

**Table no.7 Prognostic accuracy of different parameters**

| Parameter | AEC | CRP | JPS |
|---|---|---|---|
| Cut-off value | <45 | >40 | >11 |
| Sensitivity% (95%CI) | 93.75% (69.77-99.84%) | 100% (79.4-100%) | 50% (24.65-75.35%) |
| Specificity% (95%CI) | 100% (95.89-100%) | 61.36% (50.38-71.56%) | 100% (95.89-100%) |
| Positive predictive value % | 100 | 18 | 50 |
| NegativePredictive value % | 99.4% | 100 | 95.8 |
| Area under ROC (95%) | 1.0 | 0.99 (0.98-1.0) | 0.99 (0.99-1.0) |

P <0.0001

Table.7 shows the prognostic accuracy of AEC, CRP and JPS. Sensitivity and specificity and predictive values were calculated for the cut off which determined the best discrimination as derived from the ROC curves. AEC was found to have the highest discriminative value AUROC 1.0 compared to CRP and JPS. P value <0.05 was considered statistically significant.

# DISCUSSION

Perforation peritonitis is a frequently encountered surgical emergency in tropical countries like India, most commonly affecting young men in their prime of life. Most of these patients present with perforation of the upper gastrointestinal tract. In a majority of the cases, presentation to the hospital is late with well-established generalized peritonitis with purulent / fecal contamination and varying degrees of septicemia. Assuming that the patients with peptic ulcer perforation are septic upon admission, the determinants of mortality in sepsis should hold true for perforation peritonitis as well. It is necessary to recognize patients at risk preoperatively and prepare for an intensive postoperative management strategy. This becomes more significant in our setup, where the intensive care facilities are limited and overwhelmed by the number of patients.

Eosinopenia is a form of agranulocytosis where the number of eosinophil granulocytes is lower than expected. Eosinopenia per se is a very rare event(94). It has been associated with enteric fever where there is anemia, leukopenia and eosinopenia in the haematological profile(95).

One distinctive aspect of acute inflammation is the rapid and persistent decrease in the number of circulating eosinophils the reason for which remains unclear(96-98). It has been postulated that the abrupt eosinopenia may be due to the migration of eosinophils to the site of inflammation as a response to the release of chemotactic factors of inflammation into the blood stream(99).

The precocity and precision with which the eosinophil trend follows the phases of the infection underline the value of the assay as a reliable parameter for monitoring acute infection(100). Many recent studies have concluded eosinopenia as an accurate marker in blood stream infections in critically ill patients.

Abidi et al found eosinopenia as an early marker of mortality in critically ill patient . Also he found that eosinopenia is a better marker of blood stream infections in critically ill patients than CRP and procalcitonin(94-96).

Jose Garnacho et al and many others have concluded that procalcitonin and CRP are better markers of sepsis than Absolute eosinophil count(101). The initial differential diagnosis between SIRS and sepsis is quite difficult most of the times in patients presenting to

tertiary care institution. Clinical signs of infection are nonspecific and the identification of the culprit pathogen is not available in the early hours. Sepsis is associated with a strong acute-phase response resulting in pronounced changes in the concentrations of many plasma components. Apart from their values in discriminating no-sepsis-SIRS from sepsis, several biochemical indicators have been assessed regarding their potential in predicting prognosis.Of these procalcitonin appears to be good diagnostic marker of sepsis.

However, some authors have questioned its capacity to discriminate infection from controls [97,98]. These observations only confirm that testing for goodness of fit with the data, to which it is being applied, is a must for any prognostic scoring system or biomarker. Geographical variation in the different patient subsets makes such testing and validation mandatory. Since each surgical/medical unit serves a different patient population, each score system/biomarker must be calibrated and may have different cut-off values (disease or setting specific) in the individual hospital to ensure that the model is applicable for the patient material involved, before it is accepted as quality standard (102,103). Clearly, the septic syndrome is far too heterogeneous and complex to be reduced to a single cutoff of any surrogate marker.

Different microbes might induce distinct responses, resulting in a variable up/downregulation of circulating biomarkers and mediators (104).

Sepsis related markers research in developing countries are mainly focusing on Procalcitonin and CRP and it is widely accepted as a potential biomarker in sepsis(105). Only few studies are available in this setting of eosinopenia as a marker of survival in peritonitis(106).

Many research and educational programs are being done at national and international level to improve the outcome of severe sepsis. On the other hand the developing countries are struggling in many ways to identify the patients as high risk and to treat them with intensive therapy since the resources are limited.

JPS was identified first and used in response to this need since it does not use expensive investigations considering it to be a user friendly risk stratification scoring system and can be used at a wider scale. Addition of AEC to this can identify patients with better prognosis but have higher JPS.

AEC is a simple test as it is part of the Complete blood count tests being routinely done for patients admitted in intensive care setup. It does

not cause any extra effort or expenditure loss.AEC allows timely identification of patients at high risk for sepsis related mortality.

CRP has also been found to be a promising marker of sepsis but cost constraints prevent its use as a routine marker of sepsis especially in critical care setup in developing countries.

We have used ROC curves to compare the diagnostic accuracy of AEC,CRP and JPS as it compares test accuracy over different cut off values and provides tools to select optimal models for decision making(107).

# CONCLUSION

From this study, we conclude that

- AEC is a reliable marker of survival and it allows timely identification of high risk patients .
- It can be used as a marker for risk stratification in perforative peritonitis patients.
- AEC has the necessary sensitivity and specificity in addition to easy methodology and cost effectiveness as seen with other markers of sepsis.

## SCOPE OF THIS THESIS

Limitations of our study include small sample size and the patients of high risk group from a single centre. Cost and methodological constraints prevented us from getting culture for fungal infections, which have been shown to affect prognosis adversely in our patient population The concept is appealing and warrants larger prospective studies.

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# Informed Consent

Name: Age/ Sex: IP:

I herewith declare that I have been explained in a language fully understood by me regarding the purpose of this study, methodology, proposed intervention, plausible side effects, if any and sequelae.

I have been given an opportunity to discuss my doubts and I have received the appropriate explanation.

I understand that my participation in this study is completely voluntary and that I am free to withdraw from this study at anytime without any prior notice &/ or without having my medical or legal rights affected.

I permit the author and the research team full access to all my records at any point, even if I have withdrawn from the study. However my identity will not be revealed to any third party or publication.

I herewith permit the author and the research team to use the results and conclusions arising from this study for any academic purpose, including but not limited to dissertation/ thesis or publication or presentation in any level.

Therefore, in my full conscience, I give consent to be included in the study and to undergo any investigation or any intervention therein.

Patient's Sign Investigator's Sign

(Dr.MANIVANNAN.V)

DECREASE IN ABSOLUTE EOSINOPHIL COUNT AS A RELIABLE MARKER OF MORTALITY IN PERFORATIVE PERITONITIS

Investigator: **Dr.MANIVANNAN.V** , PGY3 – MS (Gen Surg)

Guide: **Prof. DrT.S.JAYASHREE, MS**

- NAME : SL. NO:
- AGE /SEX:
- ADDRESS WITH CONTACT NUMBER:
- IP NO:
- DATE OF ADMISSION:
- DATE OF SURGERY:

:

**HISTORY OF PRESENTING ILLNESS:**

Pain :orgin duration , location , character

Nausea,Vomiting: onset : duration:

Fever:duration pattern

Any other relevant history

**PAST HISTORY:**

WHETHER A KNOWN CASE OF DM/HYPERTENSION/ASTHMA/TB/EPILEPSY/CARDIAC ILLNESS

H/O previous surgery, H/O drug intake

**CLINICAL EXAMINATION:**

**GENERAL EXAMINATION:** Conscious ,oriented, hydration

**TEMP:** **P.R:** **B.P:** **R.R**

Urine output:

**SYSTEMIC EXAMINATION:**

CVS-S1S2

RS-NVBS

PER ABDOMEN: tenderness , Guarding, Rigidity,

Bowel sounds :

PER-RECTAL:

**CLINICAL DIAGNOSIS**:

## Investigations:

| **HEMAT** | | **LFT** | | **RBS** | |
|---|---|---|---|---|---|
| HB | | T.BIL | | UREA | |
| PCV | | D.BIL | | CREATININE | |
| RBC | | AST | | **ELECTR** | |
| TC | | ALT | | NA | |
| DC | | ALP | | K | |
| PLT | | T.PROTEIN | | CL | |
| ESR | | S.ALB | | HCO3 | |
| **AEC** | | P.T - T/C INR | | AMYLASE LIPASE | |

CHEST X RAY : AUD ABD ERECT X RAY:

**Jabalpur prognostic score**

| Factor | 0 | 1 | 2 | 3 | 4 | 5 | 7 |
|---|---|---|---|---|---|---|---|
| P-O interval (Hrs) | <25 | 25-72 | 73-96 | 97-120 | >120 | - | - |
| Mean systolic BP (mm Hg) | 70–109 | - | 50–69 or 110–129 | 130–159 | <49 or >160 | - | - |
| Heart rate/min | 70–109 | - | 55–69 or 110–139 | 40–54 or 140–179 | <39 or >180 | - | - |
| Serum creatinine (mg/dL) | 0.6–1.4 | - | 1.5–1.9 | 2.0–3.4 | >3.5 | - | - |
| Age (years) | <45 | - | 45-54 | 55-64 | - | 65-75 | 75 or more |

P-O interval: perforation-operation interval.
Comorbid illness, if present, is given a score = 5, none if not (Defnitions of co-morbid illness were according to the APACHE II scoring system) [7].
Total score: perforation operation interval score + age score + blood pressure score + heart rate score + creatinine score + comorbidity score.
Maximum score possible is 27.

PATIENT CLINICAL COURSE:

OUTCOME OF TREATMENT:

MASTER CHART

TABLE SHOWING NAME, AGE,SEX, HEART RATE, MEAN BLOOD PRESSURE, CREATININE, AEC ,CRP, JPS, AMONG SURVIVORS

| S.NO | NAME | AGE | SEX | HR | MBP | CREATININE | P-O | JPS | AEC | CRP | CoMorbid | TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Thenavar | 38 | M | 104 | 106.5 | 0.8 | 78 | 2 | 180 | 15 | | P |
| 2 | Vasantha | 40 | F | 106 | 110 | 1 | 75 | 4 | 125 | 35 | | P |
| 3 | Thresha | 47 | F | 112 | 93 | 0.9 | 48 | 5 | 145 | 41 | | P |
| 4 | George | 53 | M | 115 | 98 | 1 | 70 | 5 | 128 | 11 | | I |
| 5 | Umapathy | 56 | M | 105 | 70 | 0.7 | 100 | 5 | 242 | 26 | | I |
| 6 | Kanniappan | 63 | M | 118 | 80 | 0.6 | 60 | 6 | 185 | 44 | | P |
| 7 | Lakshmanan | 68 | M | 95 | 83 | 0.8 | 50 | 6 | 240 | 56 | | P |
| 8 | Prakash | 34 | M | 120 | 80 | 0.5 | 78 | 4 | 175 | 38 | | P |
| 9 | Meganathan | 58 | M | 98 | 102 | 1.1 | 40 | 4 | 156 | 41 | | I |
| 10 | Sankar | 56 | M | 105 | 74 | 1 | 78 | 5 | 185 | 22 | | I |
| 11 | Subramanian | 49 | M | 112 | 75 | 1.2 | 72 | 5 | 122 | 11 | | P |
| 12 | Paul Raj | 65 | M | 99 | 86.5 | 1.3 | 48 | 6 | 192 | 15 | | P |
| 13 | Prema | 66 | F | 105 | 76.5 | 1 | 38 | 6 | 212 | 18 | | P |
| 14 | nazreen | 56 | F | 115 | 98 | 0.9 | 74 | 6 | 124 | 26 | | I |
| 15 | Chinna Samy | 49 | M | 118 | 72 | 1.3 | 45 | 5 | 225 | 33 | | I |
| 16 | Malaivannan | 65 | M | 90 | 88 | 0.6 | 26 | 6 | 156 | 48 | | P |
| 17 | Prakasham | 70 | M | 102 | 78 | 0.8 | 48 | 6 | 125 | 59 | | P |
| 18 | Premkumar | 27 | M | 121 | 80 | 0.7 | 74 | 4 | 143 | 79 | | A |
| 19 | Meenakshi | 52 | F | 88 | 102 | 1.2 | 45 | 8 | 156 | 44 | YES | P |
| 20 | Kandha | 44 | M | 134 | 78 | 1.1 | 22 | 2 | 168 | 56 | | I |
| 21 | Siva | 41 | M | 120 | 79 | 1 | 78 | 4 | 174 | 34 | | I |
| 22 | Dhilip | 43 | M | 135 | 80 | 1.3 | 100 | 5 | 201 | 45 | | P |
| 23 | mohamed | 26 | M | 128 | 94 | 0.7 | 110 | 5 | 239 | 11 | | A |
| 24 | Kandaiya | 58 | M | 101 | 86 | 1.3 | 48 | 5 | 174 | 20 | | P |
| 25 | Meena | 46 | F | 98 | 106 | 1.8 | 52 | 4 | 183 | 15 | | P |
| 26 | Velan | 29 | M | 128 | 70 | 1.5 | 98 | 7 | 169 | 24 | | A |
| 27 | Arumugam | 55 | M | 90 | 105 | 1.2 | 40 | 4 | 200 | 32 | | I |
| 28 | VijayaRaj | 45 | M | 112 | 80 | 0.8 | 78 | 7 | 158 | 22 | | I |
| 29 | Najbabee | 48 | F | 105 | 92 | 1.5 | 58 | 3 | 174 | 12 | | P |
| 30 | Padmanaban | 58 | M | 118 | 70 | 1.3 | 45 | 6 | 188 | 18 | | P |
| 31 | Rajkumar | 44 | M | 128 | 80 | 1.1 | 78 | 4 | 159 | 40 | | I |
| 32 | Angammal | 65 | F | 105 | 72 | 1.3 | 52 | 6 | 201 | 39 | | P |
| 33 | Kuppan | 75 | M | 102 | 90 | 0.8 | 22 | 6 | 200 | 35 | | C |
| 34 | Kuppusamy | 40 | M | 118 | 76.5 | 1.1 | 90 | 4 | 216 | 27 | | P |
| 35 | Isha Begum | 30 | F | 125 | 60 | 0.9 | 75 | 6 | 125 | 35 | | I |
| 36 | Selvan | 45 | M | 110 | 80 | 1.6 | 48 | 5 | 148 | 52 | | P |
| 37 | Mariappan | 40 | M | 132 | 70 | 1.2 | 92 | 5 | 136 | 33 | | I |
| 38 | Prem Kumar | 42 | M | 117 | 73 | 1 | 78 | 4 | 154 | 42 | | P |
| 39 | Gayathri | 48 | F | 90 | 80 | 0.9 | 52 | 3 | 125 | 15 | | I |
| 40 | Mohan | 53 | M | 122 | 75 | 1.1 | 38 | 5 | 126 | 26 | | P |
| 41 | Raja | 48 | M | 115 | 66 | 1.2 | 52 | 7 | 156 | 33 | | I |
| 42 | Manikandan | 60 | M | 92 | 70 | 1.3 | 42 | 8 | 147 | 42 | | C |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 43 | Indumathi | 42 | M | 118 | 88 | 1.5 | 38 | 5 | 128 | 27 | | P |
| 44 | Balaji | 49 | M | 109 | 72 | 1.3 | 82 | 4 | 193 | 21 | | I |
| 45 | Arunachalam | 35 | M | 124 | 64 | 1 | 52 | 5 | 132 | 39 | | P |
| 46 | Rajendran | 50 | M | 98 | 71 | 1.2 | 82 | 4 | 167 | 56 | | P |
| 47 | Ramasamy | 54 | M | 112 | 74 | 1.4 | 92 | 6 | 178 | 68 | | P |
| 48 | Ponselvan | 62 | M | 102 | 86 | 1.2 | 71 | 4 | 199 | 64 | | I |
| 49 | Renuka | 45 | F | 123 | 74 | 1.3 | 56 | 5 | 231 | 55 | | I |
| 50 | Dinesh Kumar | 32 | M | 109 | 84 | 1.6 | 58 | 5 | 238 | 43 | | I |
| 51 | Sukumaran | 59 | M | 102 | 85 | 1.1 | 60 | 4 | 143 | 35 | | P |
| 52 | Maialagan | 66 | M | 109 | 65 | 1.3 | 62 | 8 | 158 | 58 | | P |
| 53 | Elango | 60 | M | 99 | 81 | 1.4 | 65 | 9 | 230 | 32 | YES | I |
| 54 | Syed Ali | 37 | M | 126 | 105 | 1 | 78 | 4 | 179 | 30 | | P |
| 55 | Durai raj | 63 | M | 106 | 104 | 1.5 | 68 | 6 | 184 | 49 | | I |
| 56 | Babu | 38 | M | 115 | 98 | 1.7 | 88 | 6 | 199 | 18 | | P |
| 57 | Mohan | 45 | M | 127 | 80 | 1.8 | 92 | 8 | 201 | 38 | | I |
| 58 | Geetha | 39 | F | 118 | 72 | 1 | 82 | 4 | 134 | 26 | | P |
| 59 | Anandhan | 34 | M | 109 | 84 | 0.9 | 92 | 2 | 156 | 33 | | I |
| 60 | Radhakrishnan | 27 | M | 112 | 72 | 0.8 | 85 | 4 | 172 | 42 | | A |
| 61 | Rajasekar | 56 | M | 119 | 82 | 1.3 | 70 | 6 | 178 | 38 | | P |
| 62 | Siva kumar | 64 | M | 109 | 70 | 1.4 | 79 | 5 | 193 | 51 | | C |
| 63 | Saravanan | 65 | M | 99 | 85 | 1.4 | 73 | 7 | 162 | 33 | | P |
| 64 | Sankar | 48 | M | 107 | 86 | 0.9 | 78 | 4 | 118 | 46 | | I |
| 65 | Rajesh | 52 | M | 115 | 74 | 1.5 | 69 | 7 | 213 | 55 | | P |
| 66 | Sankaralingam | 49 | M | 118 | 87 | 1.6 | 58 | 7 | 182 | 23 | | I |
| 67 | Mohammed | 32 | M | 105 | 80 | 0.9 | 48 | 1 | 159 | 21 | | P |
| 68 | Nallappan | 43 | M | 115 | 78 | 1.4 | 78 | 4 | 144 | 31 | | I |
| 69 | Kalaiarasan | 30 | M | 132 | 65 | 1.6 | 92 | 7 | 162 | 34 | | P |
| 70 | Gopal | 45 | M | 102 | 89 | 1.2 | 75 | 4 | 135 | 55 | | I |
| 71 | Kuppusamy | 51 | M | 105 | 78 | 1.6 | 76 | 6 | 128 | 47 | | P |
| 72 | Pavithran | 43 | M | 105 | 90 | 0.7 | 46 | 1 | 148 | 49 | | I |
| 73 | Murugan | 57 | M | 115 | 79 | 1.1 | 72 | 6 | 159 | 55 | | P |
| 74 | Govindaraj | 29 | M | 122 | 80 | 0.9 | 84 | 4 | 183 | 16 | | P |
| 75 | Moses | 43 | M | 116 | 81 | 1.6 | 76 | 6 | 199 | 28 | | I |
| 76 | Umakanth | 24 | M | 102 | 64 | 1.5 | 86 | 4 | 213 | 39 | | A |
| 77 | Jeyaraj | 54 | M | 107 | 71 | 1.7 | 80 | 6 | 240 | 44 | | P |
| 78 | Gandhi | 44 | M | 113 | 72 | 0.9 | 92 | 4 | 154 | 10 | | P |
| 79 | Masilamani | 71 | M | 108 | 90 | 2.4 | 63 | 9 | 107 | 6 | | I |
| 80 | Venkatachalam | 48 | M | 105 | 90 | 1.4 | 67 | 3 | 152 | 5 | | I |
| 81 | Gurudev | 45 | M | 122 | 77 | 1.4 | 72 | 5 | 134 | 33 | | P |
| 82 | Varadarajan | 53 | M | 112 | 73 | 1.4 | 78 | 6 | 110 | 45 | | I |
| 83 | Chelladurai | 62 | M | 105 | 70 | 1.5 | 84 | 7 | 108 | 29 | | P |
| 84 | Mathivannan | 29 | M | 114 | 88 | 0.9 | 74 | 4 | 118 | 47 | | I |
| 85 | Sudalai | 25 | M | 102 | 75 | 0.9 | 78 | 2 | 169 | 52 | | P |
| 86 | Vijayan | 45 | M | 118 | 88 | 1.4 | 85 | 6 | 216 | 35 | | I |
| 87 | Kamaraj | 52 | M | 102 | 83 | 1.4 | 76 | 9 | 145 | 33 | YES | I |
| 88 | Kabhir | 54 | M | 106 | 79 | 1.6 | 77 | 6 | 152 | 54 | | P |

MASTER CHART

TABLE SHOWING NAME, AGE, SEX, HEART RATE, MEAN BLOOD PRESSURE, CREATININE, AEC ,CRP, JPS, AMONG SURVIVORS

| S.NO | NAME | AGE | SEX | HR | MBP | CREATININE | P-O | JPS | AEC | CRP | Comorbid | TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Muthu Raman | 45 | M | 141 | 46 | 2.6 | 96 | 15 | 25 | 100 | | P |
| 2 | Sankaran | 61 | M | 125 | 53 | 2 | 78 | 18 | 45 | 108 | yes | I |
| 3 | Subramanian | 64 | M | 134 | 66.5 | 1.9 | 82 | 11 | 35 | 96 | | P |
| 4 | Rajesh | 45 | M | 145 | 76.5 | 1.5 | 75 | 14 | 44 | 78 | yes | I |
| 5 | Muthusamy | 47 | M | 138 | 56.5 | 2.6 | 90 | 11 | 23 | 65 | | P |
| 6 | elumalai | 51 | M | 144 | 63 | 3.2 | 100 | 13 | 25 | 110 | | P |
| 7 | Ezhaipangalan | 59 | M | 125 | 48 | 1.7 | 80 | 13 | 28 | 89 | | P |
| 8 | Senthamil Selvi | 61 | F | 134 | 54 | 1.8 | 40 | 10 | 30 | 78 | | I |
| 9 | Dhanalakshmi | 66 | F | 128 | 80 | 2.5 | 52 | 16 | 32 | 92 | yes | I |
| 10 | Elumalai | 56 | M | 140 | 85 | 1.9 | 115 | 11 | 35 | 86 | | P |
| 11 | Alamelu | 57 | F | 128 | 48 | 1 | 107 | 12 | 37 | 73 | | P |
| 12 | Lekshmi | 52 | F | 135 | 52 | 1.8 | 90 | 10 | 42 | 100 | | P |
| 13 | Amudha | 62 | F | 122 | 65 | 1.5 | 88 | 11 | 44 | 104 | | I |
| 14 | Selvi | 46 | F | 138 | 71 | 2.4 | 125 | 11 | 28 | 92 | | I |
| 15 | Ramaswamy | 54 | M | 127 | 76 | 1.6 | 116 | 9 | 32 | 58 | | P |
| 16 | Manikandan | 34 | M | 140 | 84 | 2.4 | 135 | 15 | 25 | 107 | yes | P |